USER AND INSTALLATION MANUAL

Note: The H6 models are certified for use in Canada only.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the Inverter[1] that shall be followed during installation, operation, and maintenance of the inverter.

Warning - These service instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform work other than that specified in the operating instructions unless you are qualified to do so.

Caution - To reduce the risk of fire, connect only to a circuit provided with 150 (H4 models), 400 (H2 models) and, 125 (H6 models) amperes maximum branch-circuit over current protection in accordance with the National Electrical Code, ANSI/NFPA 70.

NOTE: THE H6 models are certified for use in Canada only.

Warnings

A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed, could result in damage to or destruction of part or all of the Inverter equipment and/or other equipment connected to the Inverter equipment or personal injury.

⚠ **DANGER!**
“DANGER” indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING!**
"WARNING" indicates a hazardous situation which, if not avoided, could result in death or serious injury.

[1] Hereinafter referred to as all five Models (XP100U-H2, XP100U-H4, XP100U-H6, XP83U-H6, and XP90U-H6), unless specific model names are indicated.

CAUTION!

"CAUTION" indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

BURN HAZARD!

Do not touch. The Inverter contains components that become hot during normal operation.

Other Symbols

INFORMATION!

This symbol accompanies notes that you should know and use to ensure optimal operation of the system.

Wiring Requirements

All wiring methods and materials shall be in accordance with the National Electrical Code ANSI/NFPA 70, as well as all state and local code requirements. Cable sizes in the chart below are the minimum. Because the field connections are bus bars for accepting crimp lugs, larger cables can be used if needed.

Grid Connection

XP100U-H4/ XP83U-H6/ HP90U-H6/ XP100U-H6			
	Number of GRID cables	**Cable Size**	**Torque**
A, B, C, N	4	1AWG	All 194℉ (90℃) copper wire, 40 lbs-ft tightening torque
PE	1	4AWG	194℉ (90℃) copper wire, 40 lbs-ft tightening torque

XP100U-H2			
	Number of GRID cables	**Cable Size**	**Torque**
A, B, C, N	4	300kcmil	All 194℉ (90℃) copper wire, 40 lbs-ft tightening torque
PE	1	4AWG	194℉ (90℃) copper wire, 40 lbs-ft tightening torque

PV Connection

XP100U-H2/ XP100U-H4/ XP83U-H6/ XP90U-H6/ XP100U-H6			
	Number of PV strings	**Cable Size**	**Torque**
Hot, Return	1	600kcmil	All 194℉ (90℃) copper wire, 40 lbs-ft tightening torque
	2	300kcmil	All 194℉ (90℃) copper wire, 40 lbs-ft tightening torque
	4	1/0AWG	All 194℉ (90℃) copper wire, 40 lbs-ft tightening torque
PE	1	2AWG	194℉ (90℃) copper wire, 40 lbs-ft tightening torque

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1. ABOUT THIS MANUAL

This manual provides information about the Inverter. This manual contains instructions to install, operate, maintain and troubleshoot the KACO Inverter. The user must keep this manual available at all times.

This manual contains 5 sections and 3 appendixes.

Safety is important. The Inverter operates with high voltages. Improper use or control of the inverter can cause an accident and damage to the inverter or the user. The user must understand directions thoroughly in each section in order to properly install, operate, and maintain the Inverter.

1. The introduction describes the features of Inverter and details the components in the Inverter.

2. The installation & operation section details how to install and operate the Inverter and how to use the Graphic User Interface (GUI).

3. The fault & warning section contains a list of error codes of the Inverter and their descriptions.

4. The maintenance section contains directions on how to clean and replace fans, and periodically check the parts of the Inverter.

5. The parameters section contains parameter settings for the Inverter.

A. The specification section details the Inverter specifications.

B. The user Interface section will provide information about the digital interface, analog interface, Ethernet and RS485 serial connection of the Inverter.

C. The configuration section shows the configuration of the Inverter.

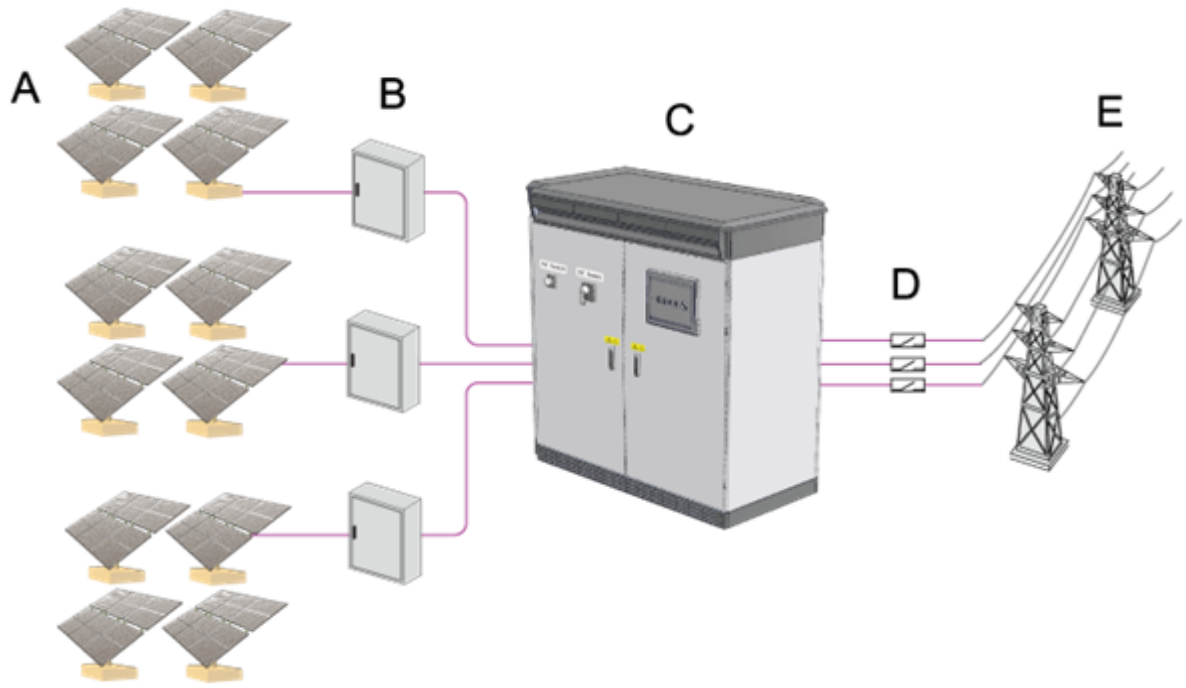
Contact Information

KACO new energy Inc.
USA
Tel: +1 (415) 931-2046
Fax: +1 (415) 931-1688
E-mail: kacoinfo@kaco-newenergy.com

2. SAFETY

Appropriate Usage

Any other application of the Inverter or installation of components and modifications which are not explicitly allowed endanger the safety and void the warranty as well as the operation permit.



A: PV Modules

B: String Combiner Box

C: Inverter

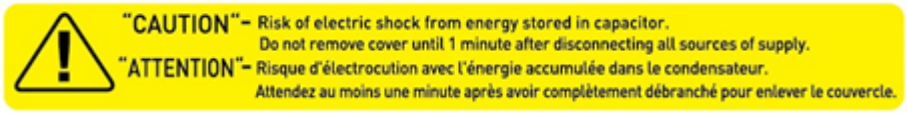
D: AC overcurrent protection

E: Grid

Basic Solar Power System with the Inverter

Safety Instructions

WARNING! HAZARDOUS VOLTAGE
No user serviceable parts inside.
This unit is to be serviced by trained personnel only.
Before opening disconnect the PV generator and the grid.
Discharge time of capacitors up to 1 minute.
High leakage current. By all means establish earth connection before connecting to the supply circuit!
READ MANUAL BEFORE USE
Please read safety instructions in the manual before use.
ATTENTION! TENSION DANGEREUSE!
Aucune des pièces ne sont remplaçables par l'utilisateur.
L'entretien et la réparation de l'appareil ne peut se faire que par le personnel autorisé.
Avant d'ouvrir, veuillez déconnecter le générateur PV et le réseau
Le condensateur peut prendre jusqu'à une minute pour se décharger
Courant à haut potentiel de fuite. Faites bien attention d'établir un raccordement à la terre avant de connecter au circuit!
LIRE LE MANUEL AVANT UTILISATION
Lisez attentivement les instructions de sécurité dans le manuel avant utilisation.


"CAUTION"– Risk of electric shock from energy stored in capacitor.
Do not remove cover until 1 minute after disconnecting all sources of supply.
"ATTENTION"– Risque d'électrocution avec l'énergie accumulée dans le condensateur.
Attendez au moins une minute après avoir complètement débranché pour enlever le couvercle.

DANGER!

High voltages are present in the live components of the low voltage grid.

Death may result from burns and electric shock.

Do not touch the live components of the Inverter or low-voltage grid.

Pay close attention to all safety precaution measures regarding the low voltage grid.

⚠ DANGER!

During operation, high voltages are present in the Inverter.

Death may result from burns and electric shock.

Before commencing work on the Inverter disconnect completely and ensure that the device will not be accidentally energized.

Ensure that no voltage is present.

Ground and short-circuit.

Cover any nearby live parts.

⚠ DANGER!

Normally grounded conductors may be ungrounded and energized when a ground-fault is indicated.

Risk of electric shock.

Test before touching.

Contact customer support for information at KACO new energy, Inc. +1 (415) 931-2046.

⚠ WARNING!

Failure to follow the manual, the operating instructions and the safety precautions may lead to severe injury from electrocution.

All work on the Inverter may only be done as described in this manual and must be performed by qualified personnel.

Pay attention to all safety instructions.

Follow all operating instructions.

If problems occur when performing the work described here, contact the customer support department at KACO new energy Inc. +1 (415) 931-2046.

WARNING!

Operating the Inverter if it's damaged may cause severe injury from electrocution.

The Inverter may only be used when it is functioning correctly.

Regularly check the XP Inverter for visible damage and operate only if there is no visible damage.

Ensure that all safety features are accessible at any time and that their correct operation is tested regularly.

ATTENTION!

The printed circuit board (PCB) components in the Inverter can be damaged by electrostatic discharge!

When working on the Inverter and when handling the PCB components observe all ESD safety regulations. Discharge electrostatic charge by touching the grounded Inverter enclosure. Only then is it safe to touch any electronic components.

Technical rules

The installation must be in compliance with the local regulations and technical rules, in particular with regard to electrical connections. (National Electric Code NEC)

The installer is responsible for knowing and understanding local standards and regulations as well as utility interconnection requirements.

Regulations concerning the prevention of accidents

During the operation of the inverter, certain parts of the device carry high voltages, which may lead to severe personal injury or even death. The following precautions should be followed to minimize the risk of lethal hazards or personal injuries.

The installation of the device must be in compliance with the relevant safety regulations or other applicable national or local provisions. Proper ground, conductor dimensioning and an appropriate short-circuit protection must be provided to ensure operational safety.

All instrument covers must remain closed during operation.

Prior to performing some visual checks and maintenance work the inverter must be disconnected from all power sources and protected against inadvertent activation. If measurements have to be conducted while the inverter is connected to power, NEVER touch live terminals. Remove all jewelry from your wrists and fingers. Ensure that the test equipment is in a proper and safe operating condition.

When working on the inverter while energized, make sure to stand on an insulated surface and ensure that there is no connection to ground.

Follow the instructions exactly as given in these operating and installation instructions and especially observe all information concerning possible hazards, warnings and precautions.

This manual may not cover all possible scenarios. Should a specific problem occur that is not sufficiently explained, please contact your dealer or KACO new energy.

Modifications/Changes

⚠ **CAUTION!**
Hazard of damage due to unauthorized modifications/manipulation! By no means manipulate the inverter or modify or change the inverter or any other parts of the installation

Performing any modifications or changes on the inverter is generally prohibited. Performing any changes or modifications to the installation of the inverter is only permitted if in compliance with national standards and performed by qualified personnel.

Inverter shutdown

WARNING!

Hazardous live voltages can be present in the inverter even if the electrical connections are switched off or disconnected. Please wait for 1 minute before accessing the inverter

The inverter must be switched off for adjusting, maintenance and repair work. Please proceed as follows:

1. Turn the inverter off by pushing the off button in the GUI.
2. Turn the AC and DC switches to the OFF position
    a. (The off position is green and the on position is color coded red).
3. Disconnect the inverter from the PV array.
4. Disconnect the inverter from the grid.
5. Check that the inverter is disconnected from all voltage sources.
6. If possible Install lockout devices on the utility connection circuit breaker, AC and DC disconnect switches.
7. Wait 1 minute for all capacitors inside inverter to discharge.
8. When reactivating the XP inverter expect a five minute commission window.

3. THE BLUEPLANET INVERTER OVERVIEW

Full digital control using digital signal processing (DSP)

The KACO XP uses two DSPs to control the inverter and an ARM processor for user and external interface. These full digital control schemes offer enhanced reliability, accuracy, efficiency, flexibility and convenience.

High reliability

The KACO Inverter features built in reliability with redundant power supplies, highly efficient cooling of critical components and intelligent cooling fans. The fans are monitored and controlled according to load and environmental temperature conditions. All components used in the KACO XP are designed for industrial use. The IGBT stack was designed based on the IEEE WG PEBB TF2 standards. These standards mandate the use of laminated DC bus-bars that provide for very low stray inductance and gate drive interfacing with differential signaling. This feature enhances reliability and ease of maintenance. Full digital control technology of the XP also enhances reliability by reducing component count compared to traditional analog electronics.

Powerful human interface and networking

The Inverter' features a powerful and friendly Graphic User Interface (GUI). The "all-in-one" design for the GUI provides for more convenient operation and monitoring. The GUI is a big, easy to use display with color TFT LCD (480 x 272 dots) and provides detailed operating information in different languages. RS232, RS485, and Ethernet interfaces for networking are standard in the Inverter.

System flexibility

The Inverter provides 4 analog inputs, an S0 input, 1 programmable dry contact output A type (Normally open) and B type (Normally closed), and 1 digital input. The analog inputs are preconfigured for the user and allow easy connection of temperature sensors and a reference cell. The S0 input is preconfigured for smart metering.

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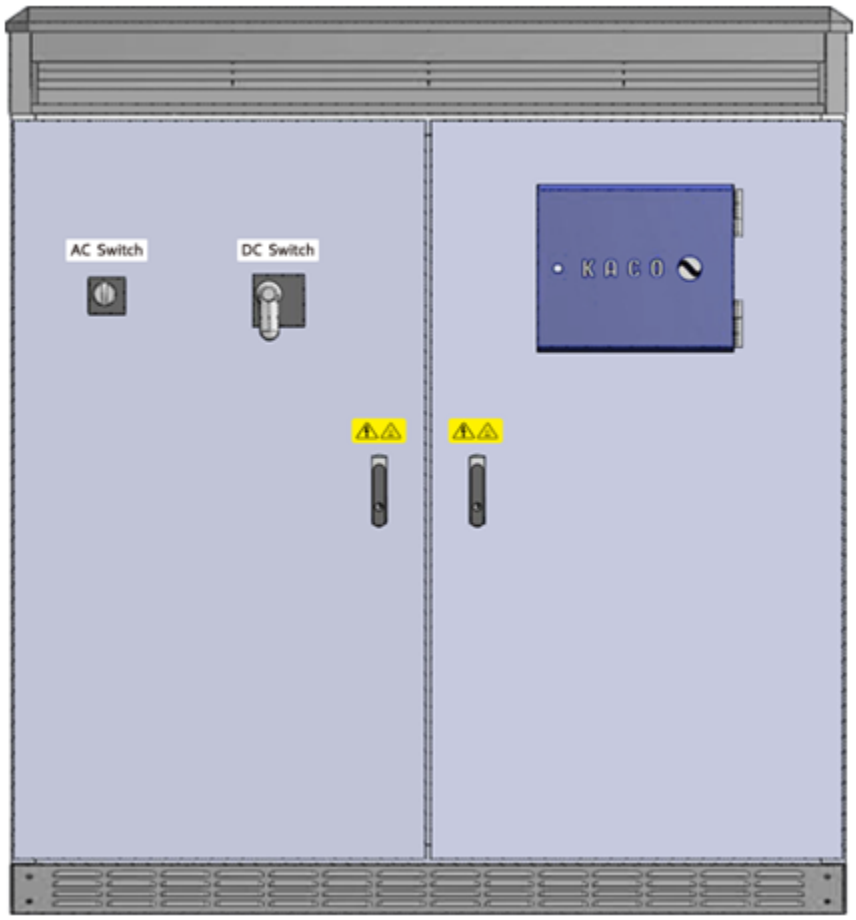
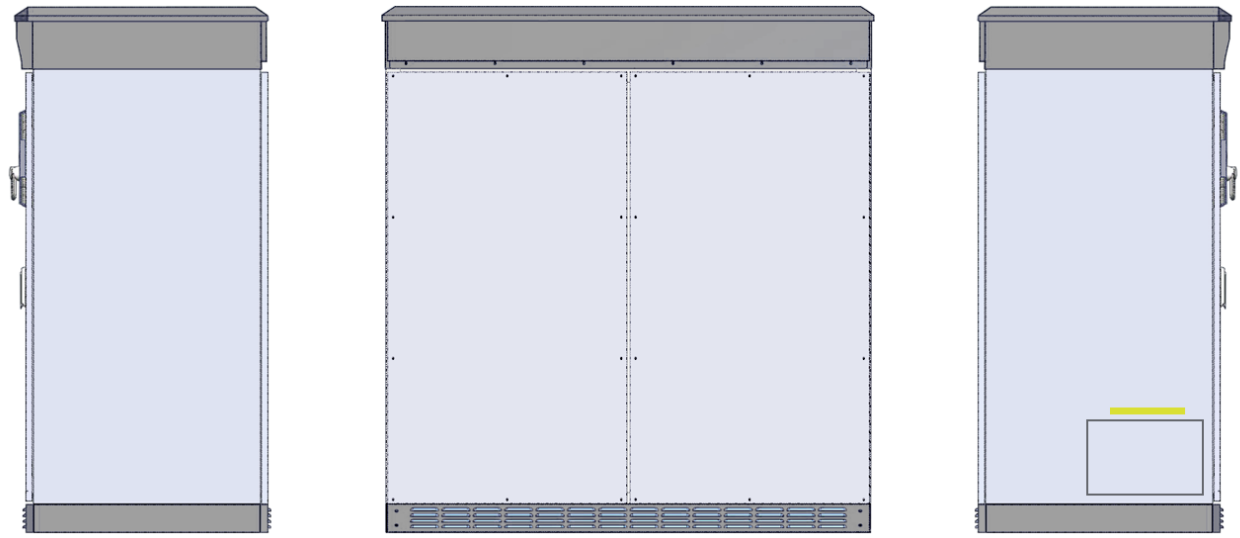
Shape & Components

External shape



Front



Left, Right and Back

Location of the Safety Notices

The figure to the right shows the location of the safety notice on the Inverter.

A. Front door handle.

Caution, risk of electric shock, hot surface

B. PEBB cover

Caution, risk of electric shock

C. Switch panel cover

Caution, risk of electric shock

D. Fuse panel cover

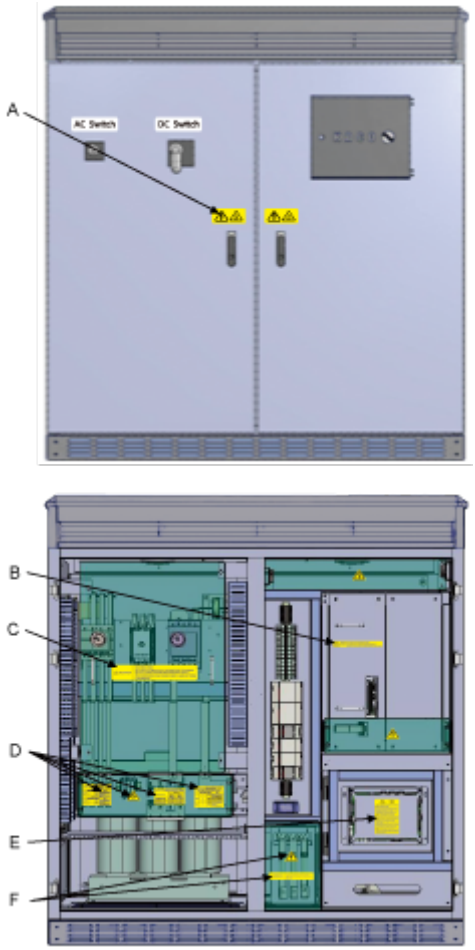
Caution, risk of electric shock

E. Control system panel

Caution, risk of electric shock
Refer to the operating instructions

F. Filter capacitor cover

Caution, risk of electric shock



The Inverter identification

You can identify the Inverter using the type plate. The inverter type identification plate can be found inside on the doors of the cabinet.

Firmware

The Inverter' firmware is shown on the display of the GUI. The Inverter' operator manual describes how to obtain the firmware version.

4. UNPACKING

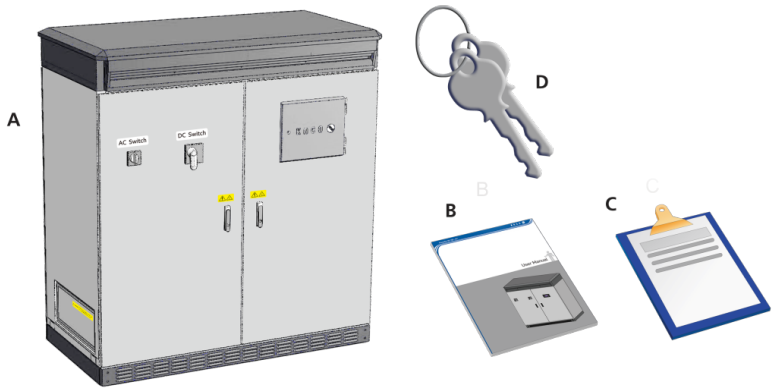
This section describes unpacking and inspection of the inverter.

Unpacking and inspection

All KACO inverters are thoroughly inspected before packing. Although they are shipped in sturdy packaging, damage can still occur during shipping and delivery. It is important to carefully inspect the shipping container and contents prior to installation. When you detect any external damage before or after unpacking, report the damage immediately to your KACO dealer and the shipping company that delivered the unit. If it is necessary to return the Inverter, please use the original packing material.

If you need assistance with damaged inverter, contact your dealer or KACO new energy Inc.

Contents



A: Inverter

B: User and Installation Manual

C: Test Report

D: Keys for GUI cover and front door

Storage

ATTENTION!
The inverter should be properly stored to ensure optimal performance.

The inverter should be closed when stored to protect from dust and moisture.
If the storage period is longer, the inverter should be kept in a dry place.

5. INSTALLATION & TRANSPORTATION

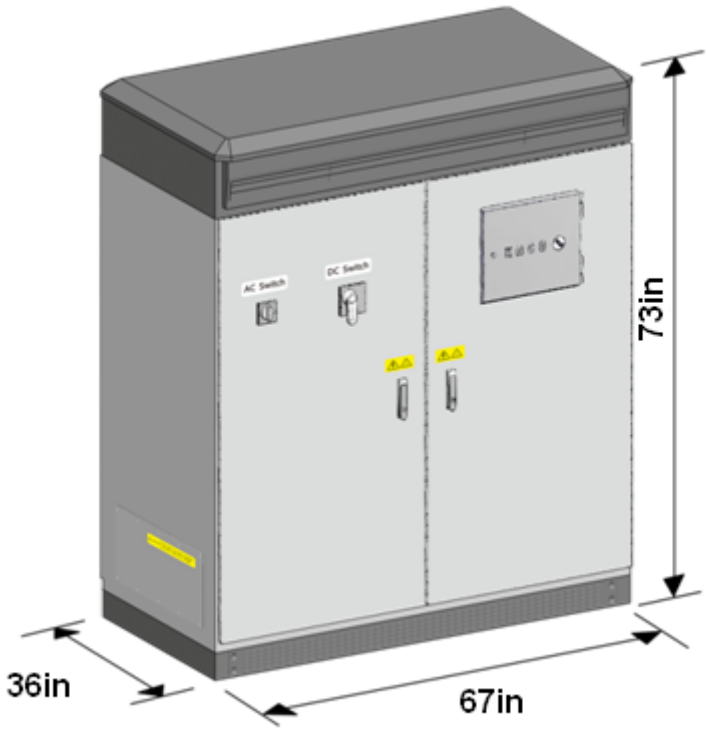
Selecting an appropriate place of installation

If possible the inverter should be installed in an area that is as dry as possible. This is to ensure maximum product longevity. Additionally, if the ambient temperature at the installation site is above or below the specifications designated by the manufacturer, the inverter should then be mounted indoors where the ambient temperature can be controlled within the specifications. Again, this is in order to ensure maximum product longevity.

The following rules should be observed while choosing the site for the installation of your inverter:

1. Ensure good access for assembly or service work.
2. Please ensure free air circulation at the sides of the housing.
3. The place of installation must ensure proper heat dissipation. If necessary, provide forced ventilation of the room to ensure that heat is dissipated adequately.
4. Ensure that the supporting area has an adequate load-bearing capacity.

Weights and Dimensions



XP100U-H2: Weight: 1400Kg

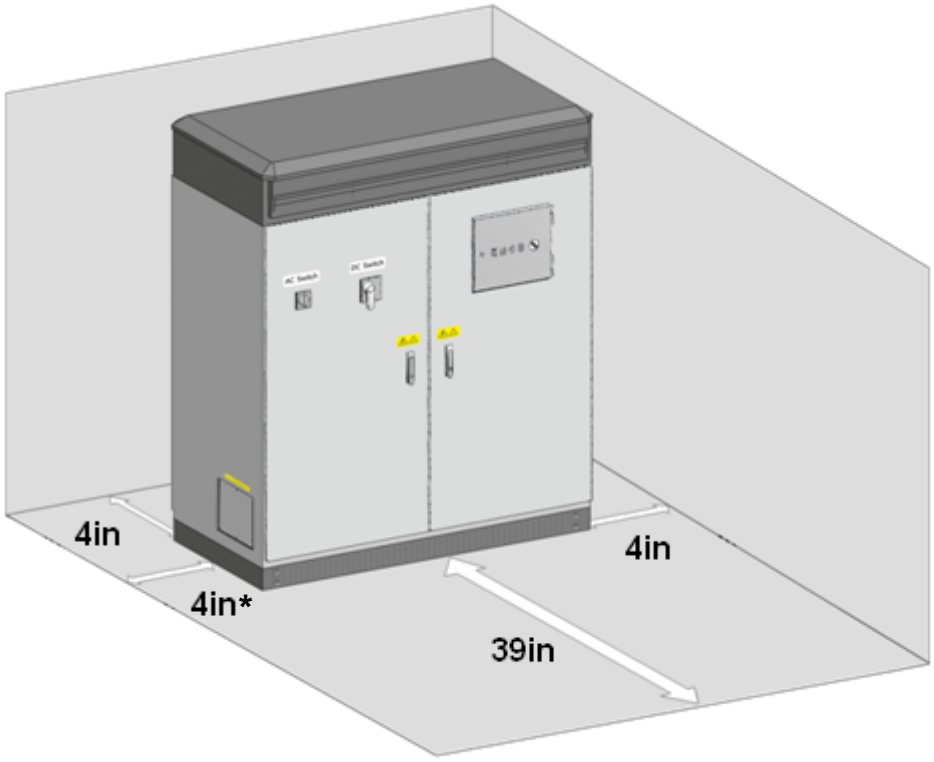
XP100U-H4: Weight: 1400Kg

XP83/90/100U-H6: Weight: 1100kg

The installation site must be easily accessible for installation or service work and should preferably not expose the inverter to direct sunlight or enclose the inverter in an unventilated space.

Minimum Workspace Requirements

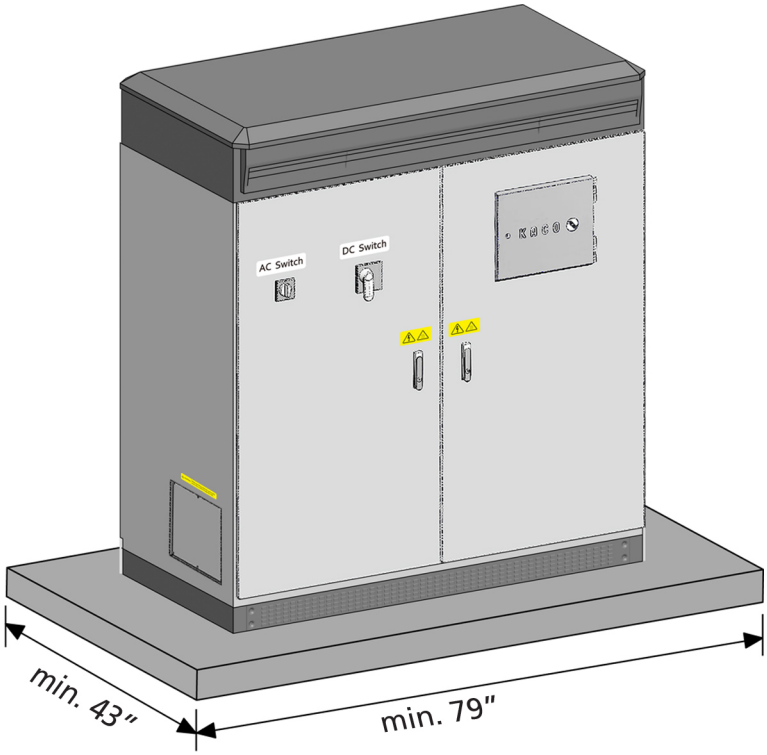
The minimum clearance space shown below should be maintained for ventilation and access.



* If you use a left side conduit plate, the minimum clearance is 4 inches on the left side for installation but actual clearance will be dictated by the requirements of conduit fitting installation and maintenance accessibility.

Installation Site Requirements

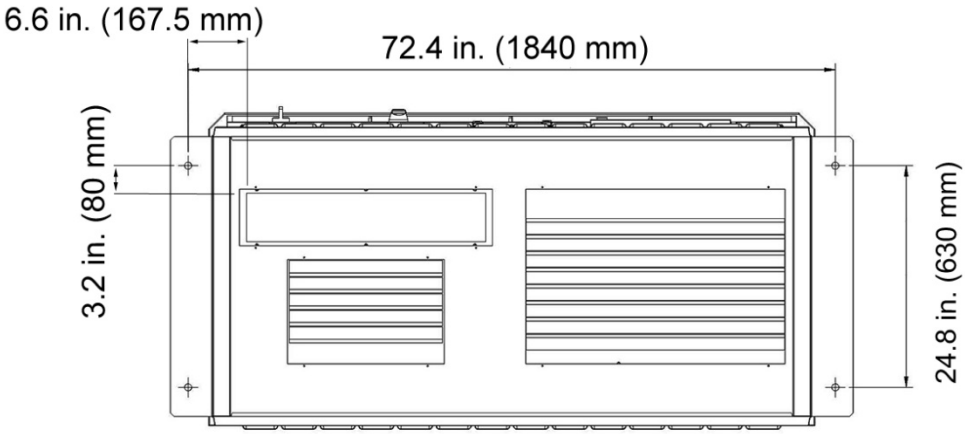
The foundation must guarantee a solid and safe surface to bear the weight of the inverter.



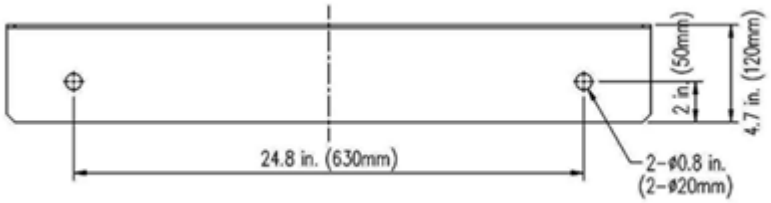
Preparation of the mounting surface

Prepare the mounting surface structure appropriately based on the chosen site

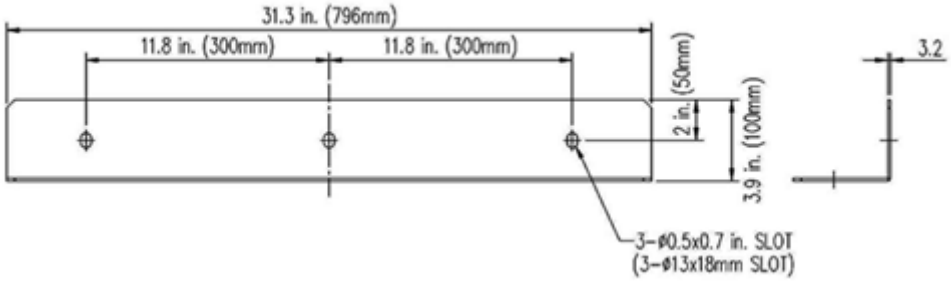
Secure the Inverter to the chosen site with the pre-installed L-brackets.



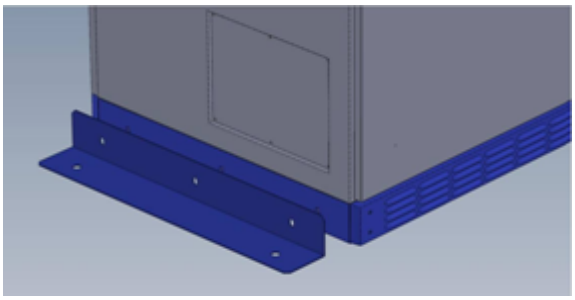
Position of the mounting holes (bottom view)



Foundation L-bracket surface mount



Mounting L-bracket to the inverter



L-bracket for mounting

Transport Instructions

Please note the weight of the inverter and follow the instructions below.

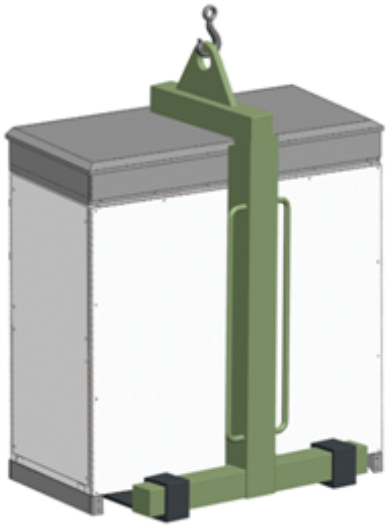
The mode of transportation must support the weight the inverter.

During transport be certain to center the weight of the inverter as the center is closer to the left side.

Do NOT tilt the inverter while transporting.

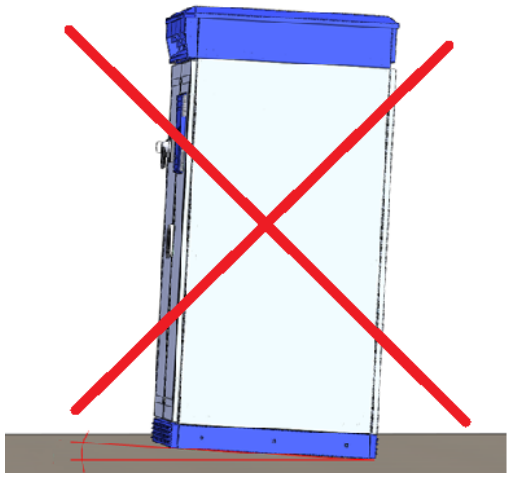
The pictures below are examples for transportation.

Fork lift from front or rear



Crane fork from front or rear

Eye nuts with crane rack



Slope angle = 0° in any direction

6. CONNECTING THE CONDUIT

In this section, see how to insert the cables in the inverter and where to punch the holes for the conduit fittings.

NOTICE!

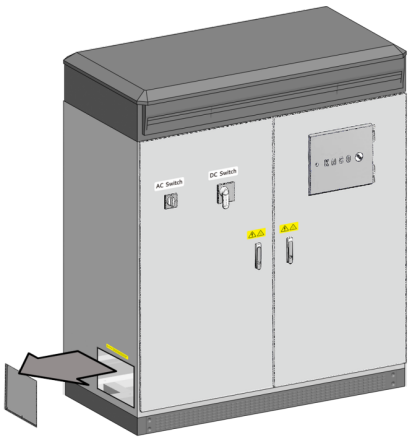
When installing, please be cautious that water is not able to enter into the inside of the cabinet. Only recognized NEC compliant watertight conduit and fittings must be used for outdoor applications. Moisture can affect the performance of the inverter through improper conduit or hubs.

How to install the cables

There are two ways of connecting cables shown in the following figures.

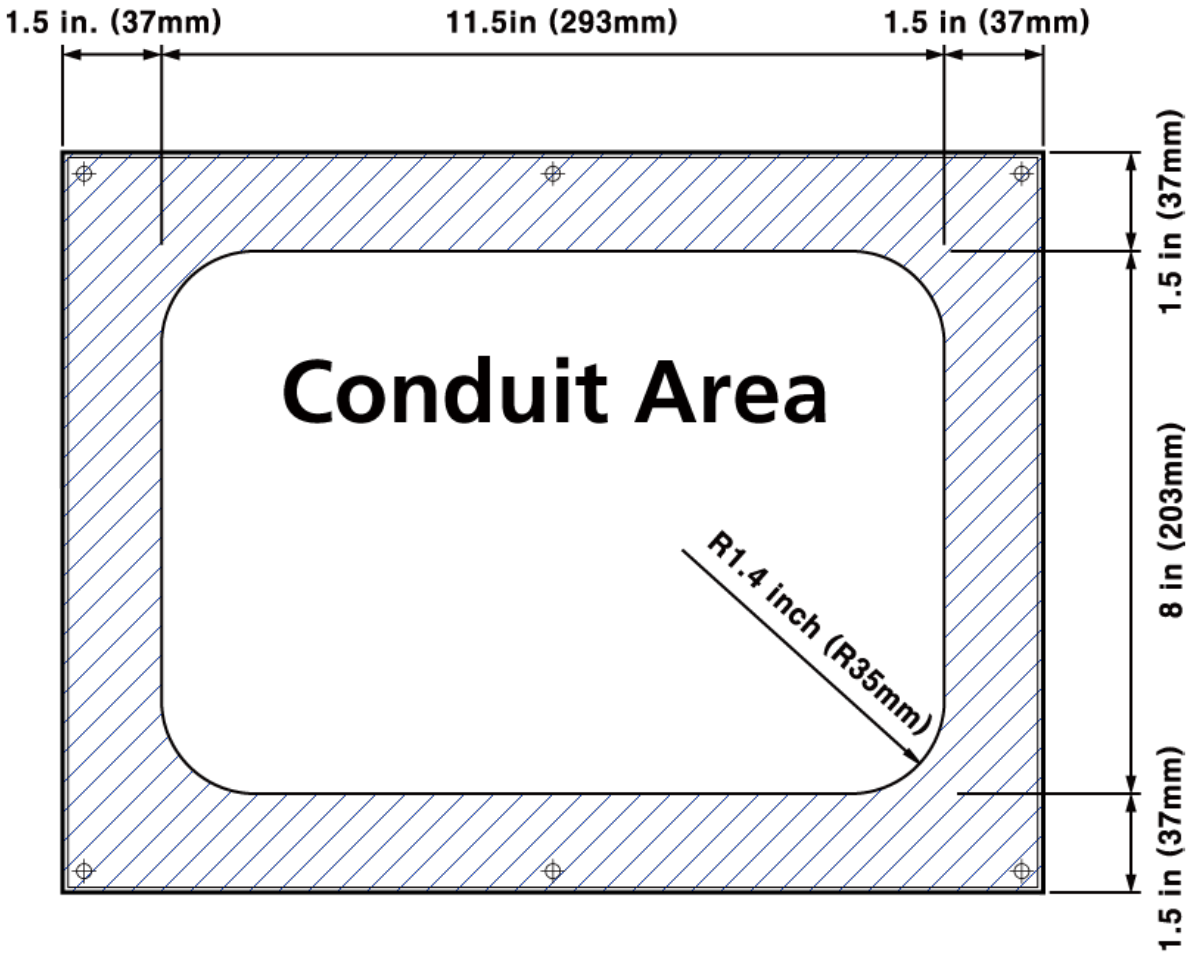
The field wiring area is designed for DC cable, AC cable and data cables.

The conduit entry points can be used for any cables. Example: Left side for DC conduit and bottom for AC conduit.

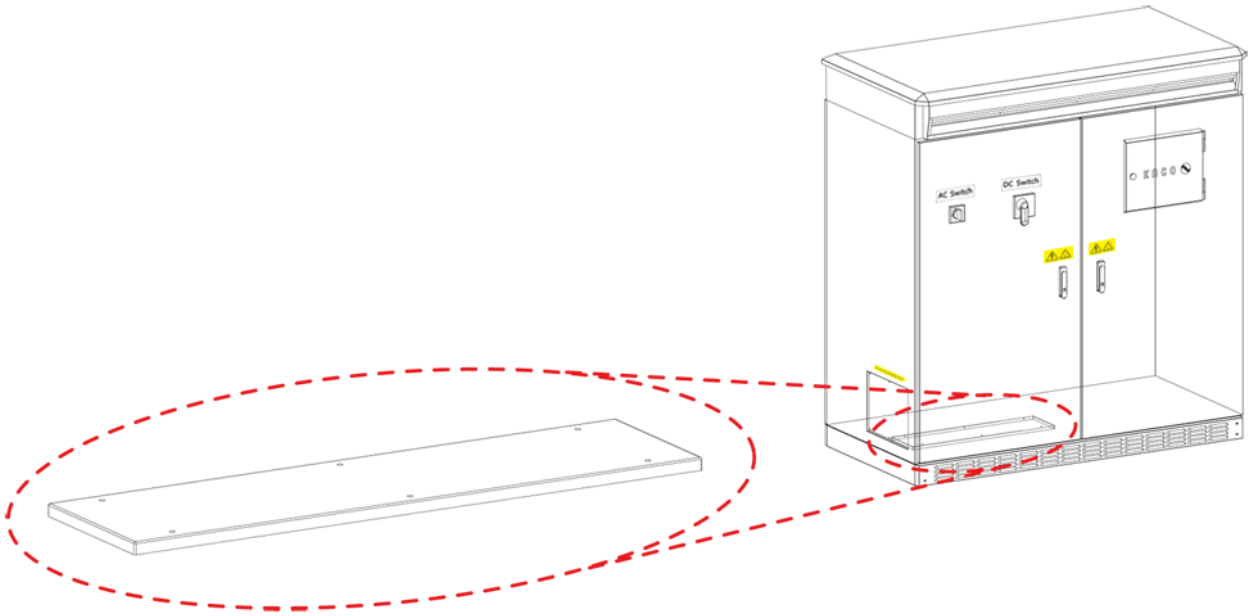


Using the left side panel for cables

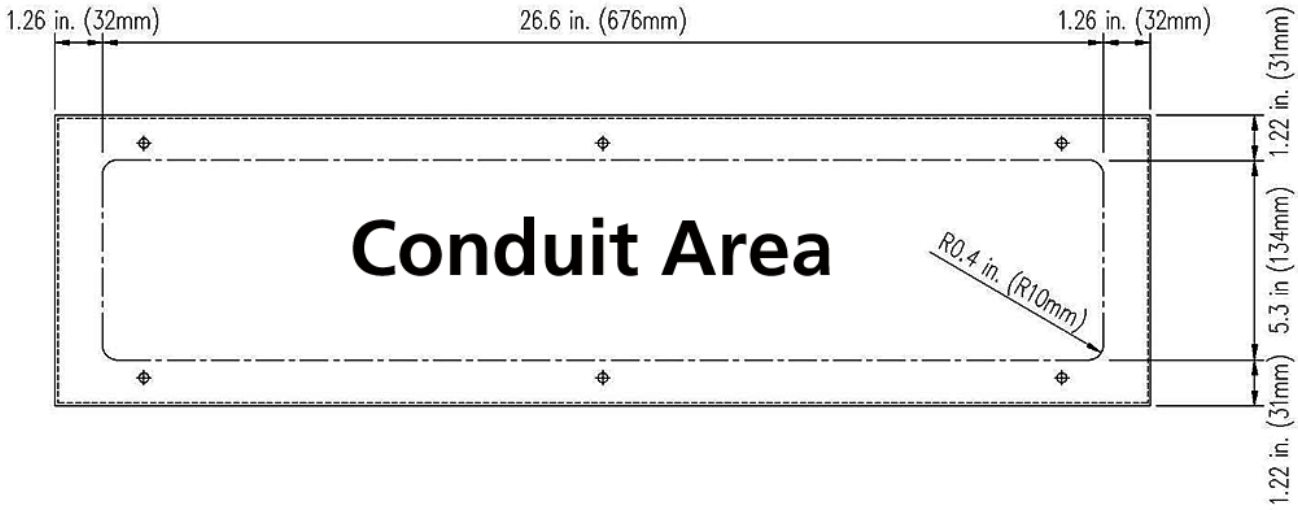
1. Remove the bolts which secure the plate to the inverter.
2. Remove the plate.
3. Mark all the holes for the conduit. You need conduit for the AC, DC and data cables.
4. Punch holes for the conduit.
5. Attach the plate to the Inverter.
6. Attach the bolts and tighten.
7. Attach the conduit with the appropriate conduit fittings.
    a. Ensure that proper conduit duct sealant is used to prevent rodent and insect infestation.
    b. The bottom plate must be secured in place during operation. If conduit is used, the proper conduit fittings must be used.



Left panel dimensions for conduit



Using the bottom panel for conduit



Bottom access panel for conduit

7. ELECTRICAL CONNECTION

The electrical connections should only be made after the inverter has been installed in its final location. To complete the electrical connections, the AC and DC terminal connections must not be connected to any source of voltage. This will protect the installer from harm and ensure that the inverter is not accidentally activated.

⚠ CAUTION!

After the inverter has been installed in the fixed location, the electrical connection can be established

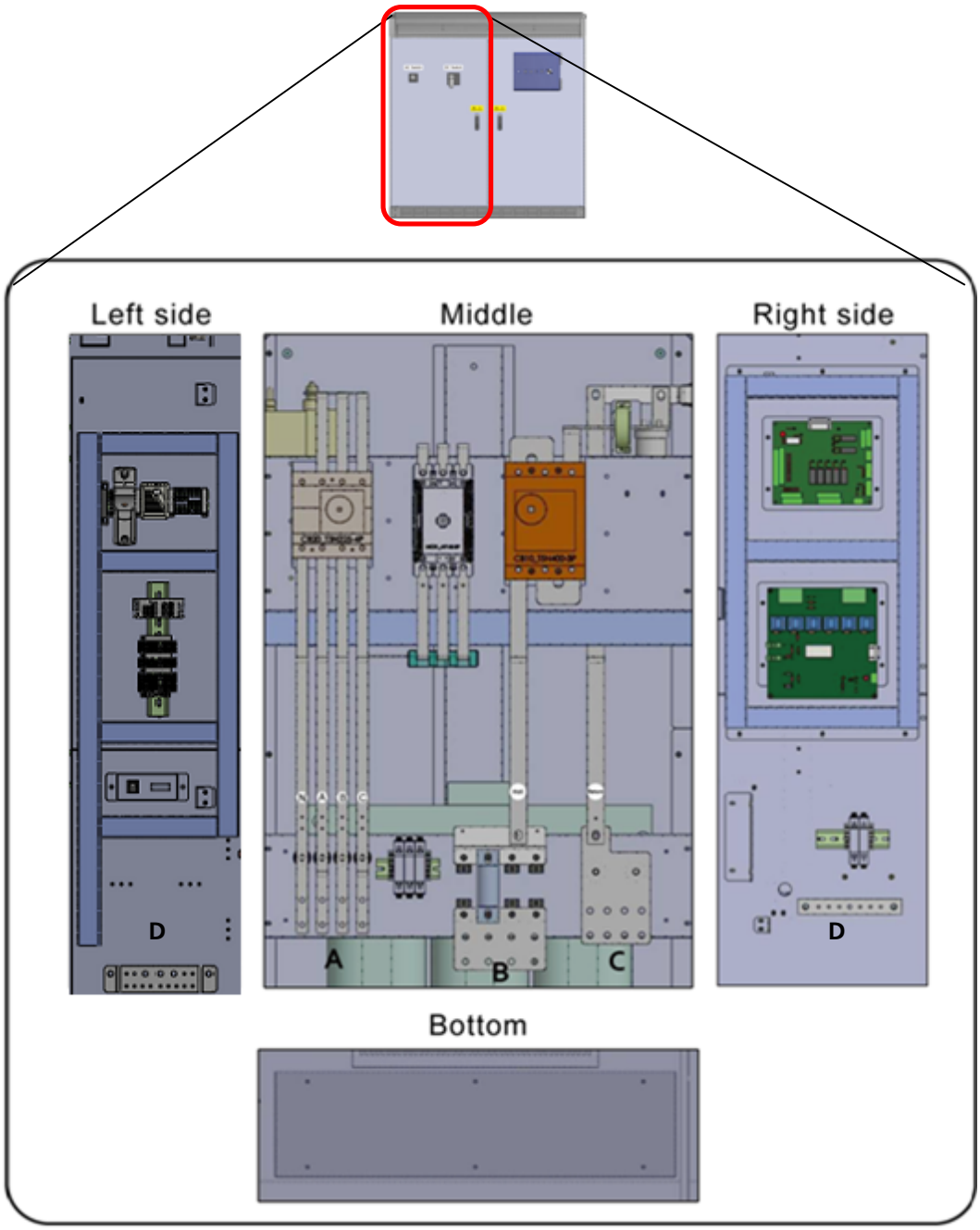
Please be sure that both AC and DC side are disconnected from all voltage sources.

Please be sure that the switches are locked out and switching-on unintentionally is not possible.

NOTICE!
The electronic printed circuit board components in the inverter can be damaged by static electricity.

➡ When handling the printed circuit boards, please follow ESD safety regulations.
To prevent the damage from static electricity, touch the enclosure of the grounded inverter.
Please go to the next step when you are sure it is safe.

Connection Area



A: AC Connection

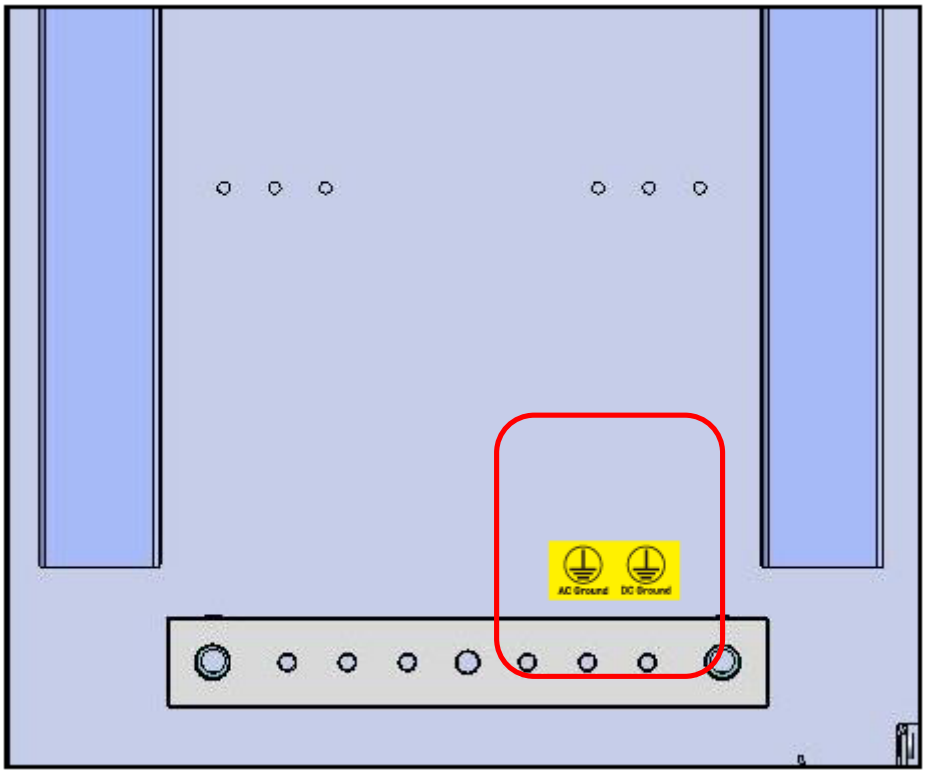
B: DC Hot Connection

C: DC Return Connection

D: Ground Connection

PE Connection

PE (Protective Earth) or Ground rails are located on both sides of the field wiring enclosure. Please ensure the Ground rails are connected with cables. Any of these connection points can be used for the Grounding Electrode Conductor (GEC) and bonding conductors.



⚠ **CAUTION!**
Before connection, please check that all external cabling is connected properly and not able to be energized accidentally.

Grid Connection

The inverter is connected to the grid through AC bus bars which are located on the left bottom of the field wiring area of the inverter which are labeled A, B, C, and N. The minimum cable size is 1 AWG for both H4 and H6, and 300kcmil for the H2 model. The torque value for AC terminal connections is 40 lb-ft. The maximum AC overcurrent protection is 125A for the H6 model, 150A for the H4 model, and 400A for the H2 model.

NOTE: The AC service must be a three phase wye connection and the neutral conductor must be used.

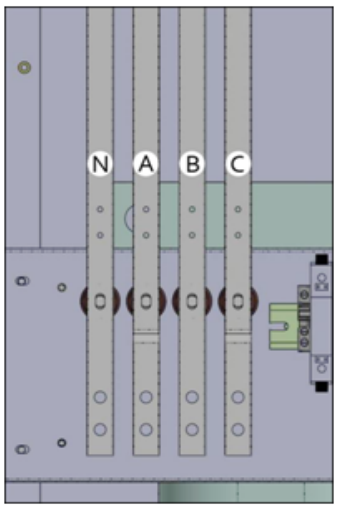
⚠ DANGER!

Electric shock can result from handling the components with high-voltage present.
Please be sure that all voltage sources are disconnected and cannot be accidentally energized.

⚠ CAUTION!

The inverter AC connections must have the proper phase rotation in order to connect to the grid and operate. Proper rotation is A-B-C. Please check with a phase rotation meter.

If the phase rotation is incorrect an error will be displayed on the user interface and the inverter will not connect to the grid, if this happens reverse any two phases to correct the rotation.



IMPORTANT!

Please check that the cables are connected and torqued properly.
Use 90℃ copper conductors only.

	XP100U-H2	XP100U-H4	XP83U-H6	XP90U-H6	XP100U-H6
AC connection cable	A, B, C, N and PE				
Nominal AC voltage	208V	480V	600V	600V	600V
Maximum AC current	278A	120A	80A	87A	96A

XP100U-H4/ XP83U-H6/ XP90U-H6/ XP100U-H6			
	Number of GRID cables	**Cable Size**	**Torque**
A, B, C, N	4	1AWG	All 194℉(90℃) copper wire, 40 lb-ft tightening torque
PE	1	4AWG	194℉(90℃) copper wire, 40 lb-ft tightening torque

XP100U-H2			
	Number of GRID cables	**Cable Size**	**Torque**
A, B, C, N	4	300kcmil	All 194℉(90℃) copper wire, 40 lb-ft tightening torque
PE	1	4AWG	194℉(90℃) copper wire, 40 lb-℉t tightening torque

PV Connection

PV Array is connected to the inverter through the DC input bus bars which are located on the bottom right of the field wiring area of the inverter.

⚠ CAUTION!

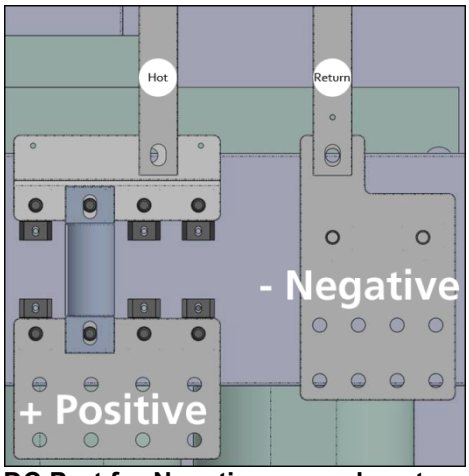
Risk of damage!
Make sure NOT to reverse polarity of the DC input.

⚠ DANGER!

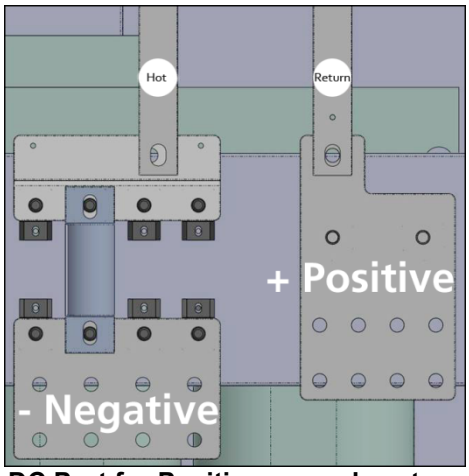
Ensure protection against hazardous live voltages during the assembly of the PV installation.
Both positive and negative leads must be correctly isolated.

⚠ CAUTION!

Each cable is related to certain polarity.
During cable connection, make sure that the cable is connected to the proper location



DC Port for Negative ground system



DC Port for Positive ground system

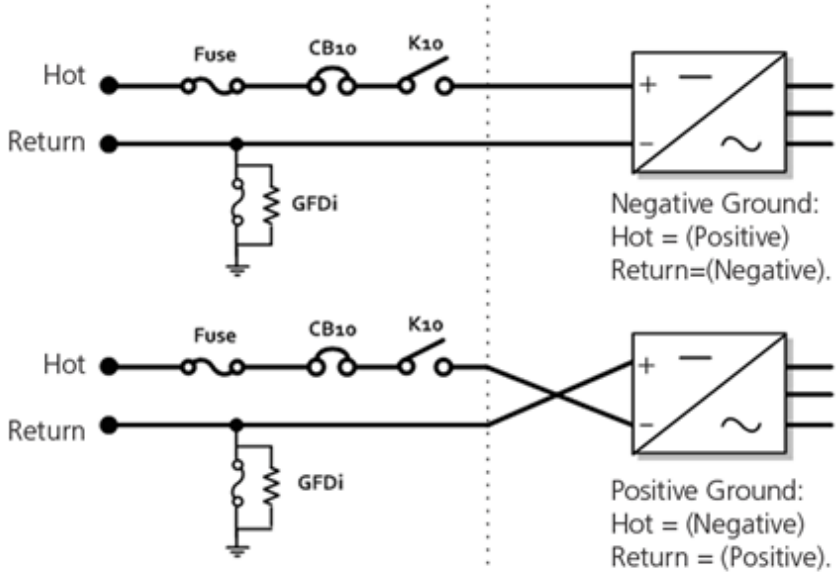
IMPORTANT!

Please check if all cables are securely fastened and torqued.
Use copper conductors only.
Check that all conduit fittings are installed correctly.
Check that all fittings are sealed correctly if installed outdoors.

	XP100U-H2/ XP100U-H4/ XP100U-H6	XP83U-H6	XP90U-H6
Number of strings	1, 2, 3 or 4 (1 fuse is standard and 2, 3, or 4 fuses are optional)		
DC input voltage	300V ~ 600V		
Maximum DC current	350A	290A	317A

XP100U-H2/ XP100U-H4/ XP83U-H6/ XP90U-H6/ XP100U-H6			
	Number of PV strings	Cable Size	Torque
Hot, Return	1	600kcmil	All 194℉ (90℃) copper wire, 40 lb-ft

			tightening torque
	2	300kcmil	All 194℉ (90℃) copper wire, 40 lb-ft tightening torque
	4	1/0AWG	All 194℉ (90℃) copper wire, 40 lb-ft tightening torque
PE	1	2AWG	194℉ (90℃) copper wire, 40 lb-ft tightening torque

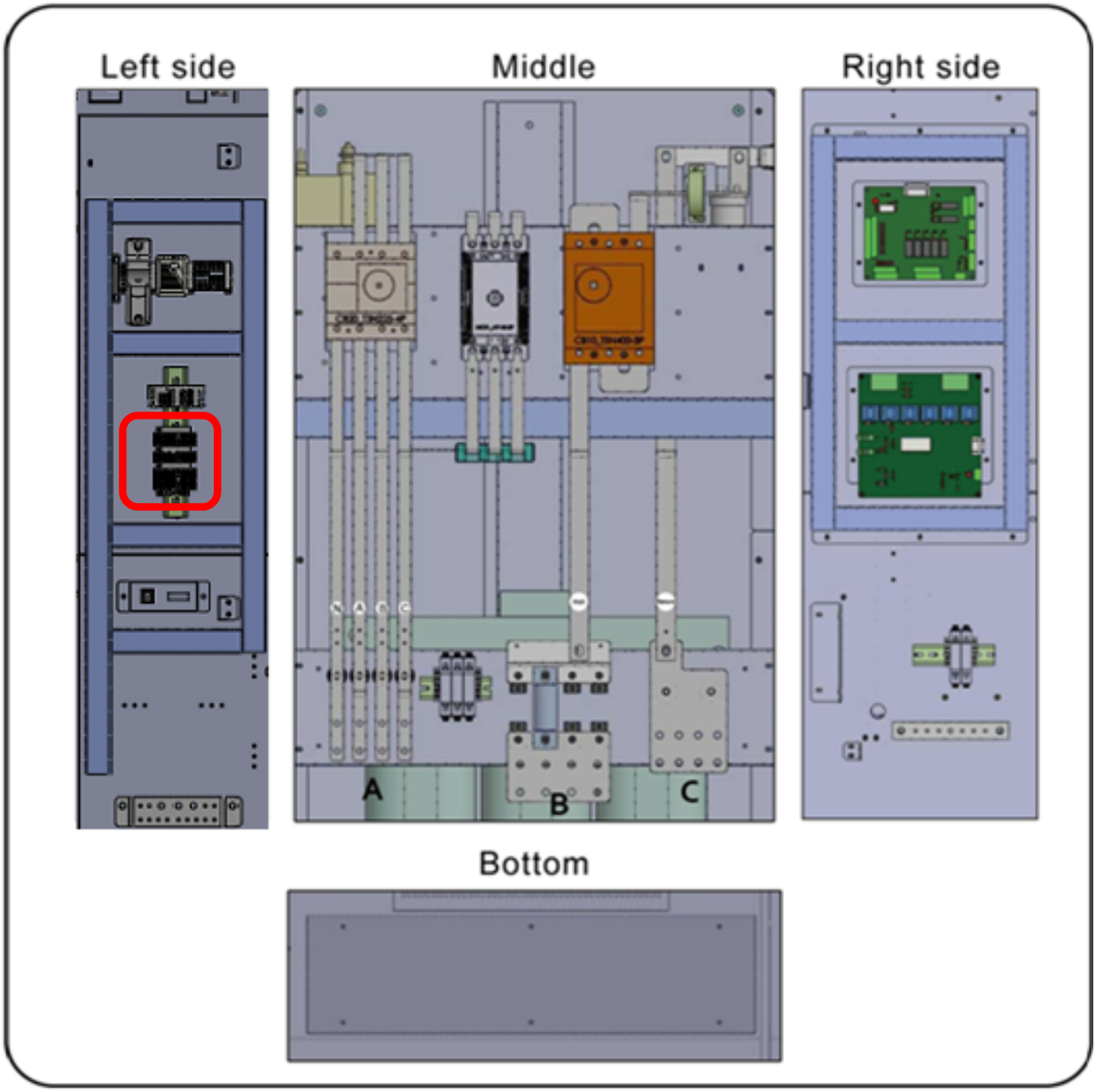


Connection Diagram

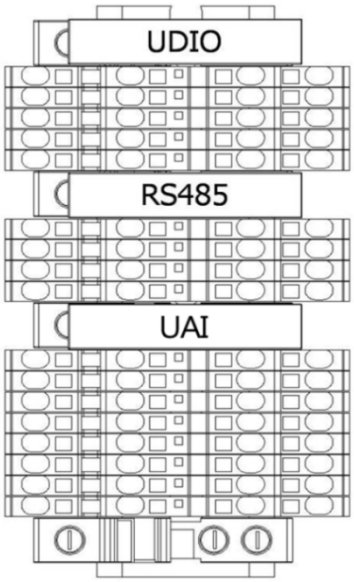
Model Name	Ground System	PV(+) Terminal	PV(-) Terminal	DC Ground Terminal
XP100U-H2 XP100U-H4 XP83U-H6 XP90U-H6 XP100U-H6	Negative Ground	Hot	Return	PV GND
	Positive Ground	Return	Hot	PV GND

DC Terminal Polarity

8. CONNECTING USER INTERFACES



User Interface of the Inverter



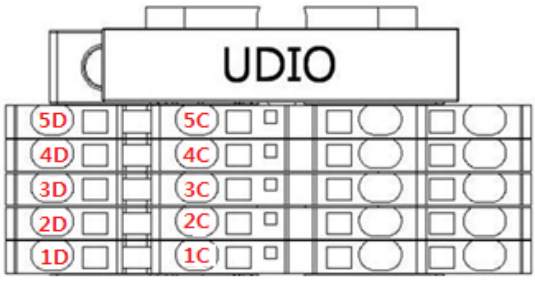
UDIO – User digital input output terminal blocks

UAI – User analog input output terminal blocks

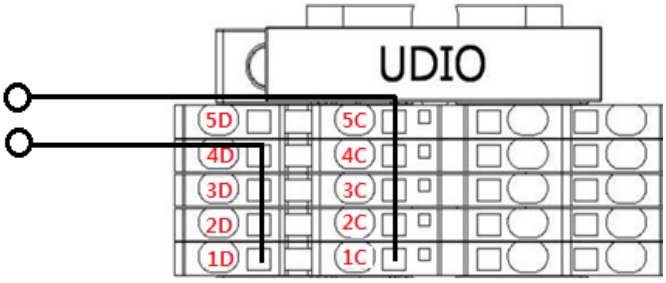
Note: On some inverters the exact location of the wires in the terminal blocks may vary. Please verify the wire numbers using the given charts.

UDIO – User digital input

Target port figure



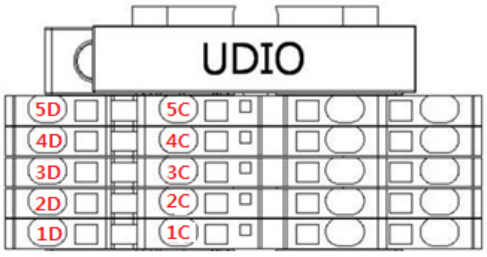
Connect the wires



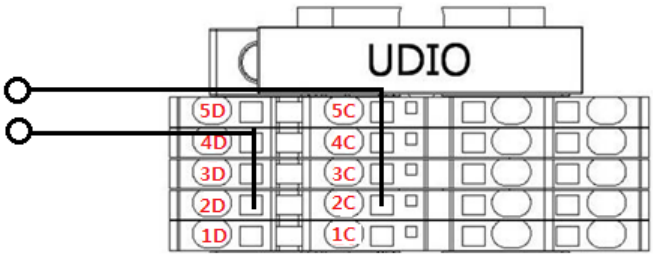
Port num.	Port name	Wire #	Specification	Wire size
1C	UDI1 P	C300	Dry contact input (24Vdc, 10mA)	18-24 AWG (0.82-0.20㎟)
1D	UDI1 N	C299		

UDIO – S0 input

Target port figure



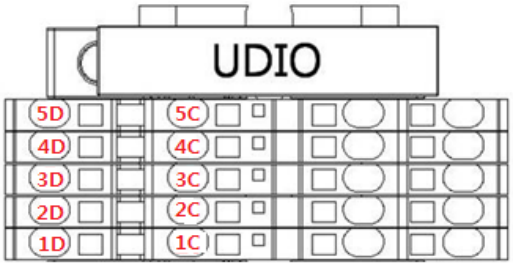
Connect the wires



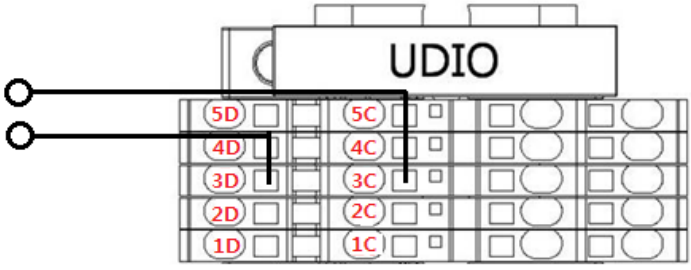
Port num.	Port name	Wire #	Specification	Wire size
2C	$S0_{in}$ P	C301	MAX 27Vdc, 27mA	18-24 AWG (0.82-0.20㎟)
2D	$S0_{in}$ N	C302		

UDIO – S0 output

Target port figure



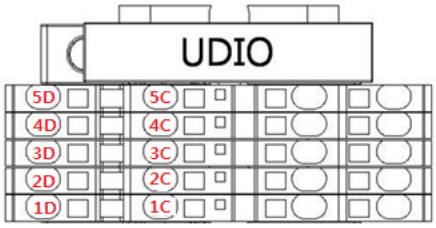
Connect the wires



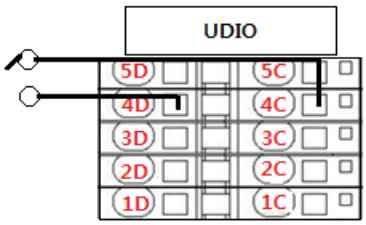
Port num.	Port name	Wire #	Specification	Wire size
3C	$S0_{in}$ P	C303	MAX 27Vdc, 27mA	18-24 AWG (0.82-0.20㎟)
3D	$S0_{in}$ N	C304		

UDIO – User digital output (relay contacts)

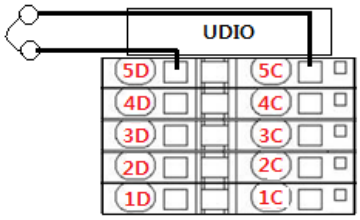
Target port figure



Connect the wires



Normally Open



Normally Closed

Port num.	Port name	Wire #	Specification	Wire size
4C	UDO1A	C305	External output N/O	18-24 AWG (0.82-0.20㎟)
4D	UDO1C	C306	External output common	
5C	UDO1B	C307	External output N/C	
5D	UDO1C	C308	External output common	

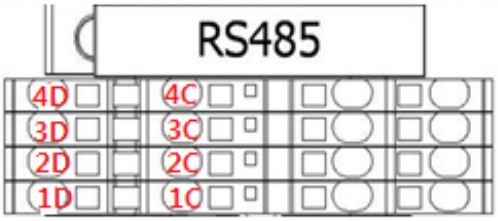
RS 485 terminal blocks

The Inverter provides two RS485 interfaces. RS485-1 communicates with the control board (XCU) and is reserved
for future use. RS485-2 communicates with the GUI and is used for standard datalogger monitoring. The connection method for each RS 485 port is detailed below.

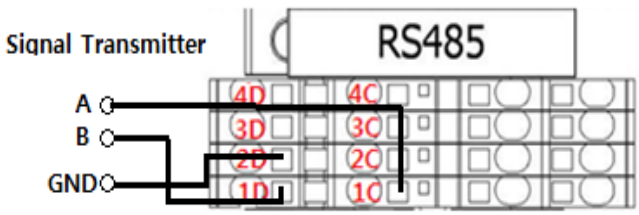
Note: Not all RS485 systems use the A and B signals in the same way thereby reversing the polarity. On some
applications, if there is no communication, reversing the polarity will allow communication.
Note: On some inverters the exact location of the wires in the terminal blocks may vary. Please verify the wire
number in the given charts.

RS485-1 (Future Use) connections

Target port figure



Connect the wires



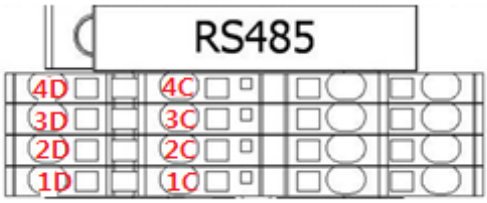
► To add termination resistance, a jumper should be connected between 1D and 2C.

Port num.	Port name	Wire #	Specification	Wire size
1C	RS485A1	C322	RS485 signal A1	18-24 AWG (0.82-0.20㎟)
1D	RS485B1	C323	RS485 signal B1	
2C	RS485C1	C324	Termination resistance setup port	
2D	RS485G1	C325	RS485 communication GND1	

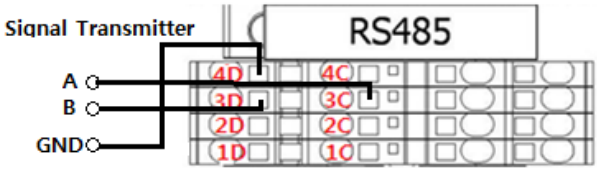
Note: Termination resistance should only be used at the beginning and the end of the RS485 chain.

RS485-2 (Data logging)

Target port figure



Connect the wires



► To add termination resistance, a jumper should be connected between 3D and 4C.

Port num.	Port name	Wire #	Specification	Wire size
3C	RS485A2	C326	RS485 signal A2	18-24 AWG (0.82-0.20㎟)
3D	RS485B2	C327	RS485 signal B2	
4C	RS485C2	C328	Termination resistance setup port	
4D	RS485G2	C329	RS485 communication GND2	

Note: Termination resistance should only be used at the beginning and the end of the RS485 chain.

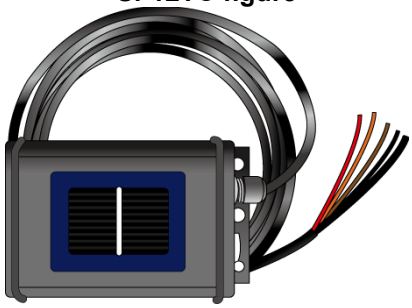
UAI terminal blocks (User Analog Inputs)

The Inverter provides 4 user analog input interface connections and 4 extra terminal blocks are provided as well for further uses. The User analog inputs are connected to an Irradiation sensor, a PV cell temperature sensor, and a PT1000 temperature sensor and a Wind Speed sensor. The user analog input interface voltage range is 0 ~ 10V. The terminal block diagrams depicted below are representative of inverters with the optional 24VDC power supply. If the inverter does not have the optional power supply, the wire numbers should be used to identify the proper connections for the sensors.

Note: On some inverters the exact location of the wires in the terminal blocks may vary. Please verify the wire number in the given charts.

Irradiance and Cell temperature Sensor (Si-12TC)

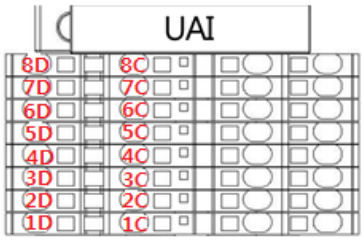
Si-12TC figure



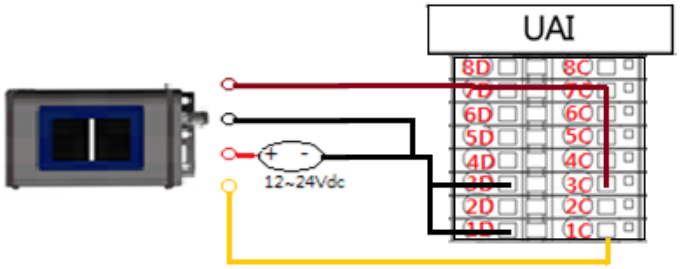
Wire description

Wire	Color	Specification
	Red	VCC(12~24Vdc)
	Black	GND
	Yellow	Irradiation value(0-10V)
	Brown	Cell Temperature(0-10V)
	Black	Frame GND

Target port figure



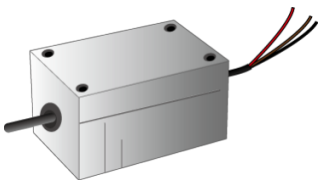
Connect the wires



Port num.	Port name	Wire #	Specification	Wire size
1C	IVP(Yellow)	C311	0V ~ 10Vdc	18-24 AWG (18-24 AWG㎟)
1D	IVN(Black)	C310		
3C	CTP(Brown)	C312		
3D	CTN(Black)	C313		

PT1000 (external temperature) sensor

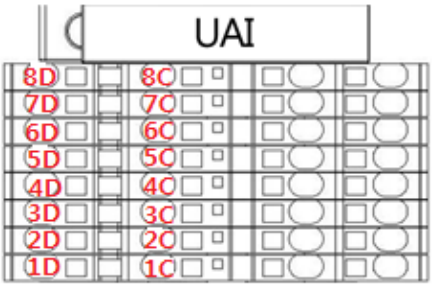
PT1000 figure



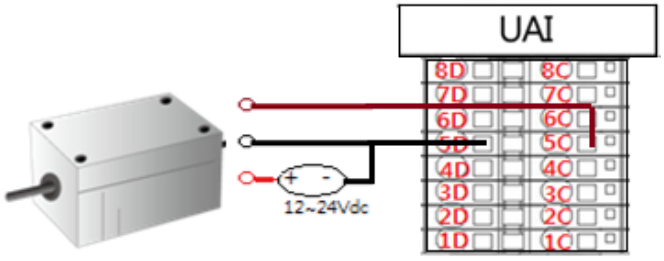
Wire description

Wire	Color	Specification
	Red	VCC(15~24Vdc)
	Black	GND
	Brown	Ambient Temperature(0-10V)

Target port figure



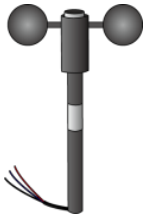
Connect the wires



Port num.	Port name	Wire #	Specification	Wire size
5C	PTP(Brown)	C314	0V ~ 10Vdc	18-24 AWG (0.82-0.20 ㎟)
5D	PTN(Black)	C315		

Wind Speed sensor

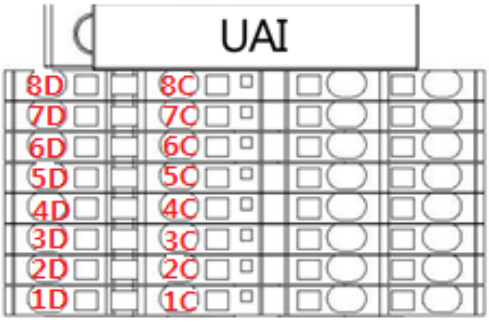
Wind Speed Sensor figure



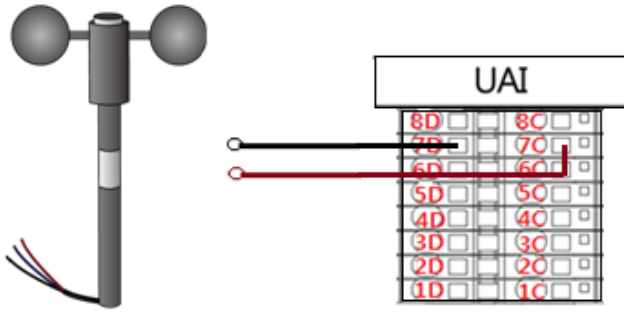
Wire description

Wire	Color	Specification
	Red	VCC(5~24Vdc)
	Black	GND
	Brown	Signal

Target port figure



Connect the wires



Port num.	Port name	Wire #	Specification	Wire size
7C	WSP(Black)	C316	Wind Speed signal (0Hz~125Hz)	18-24 AWG (0.82-0.20㎟)
7D	WSN(Brown)	C317		

To get the most accurate data from the analog interface, the user must calculate gain and offset. Then the user must change the parameters of the Inverter. The symbols for gain and offset are listed here:

M_l: lower limit of analog input by sensor.

M_u: upper limit of analog input by sensor.

D_l: lower limit of displayed value.

D_u: upper limit of displayed value.

M: input value in range of M_l and M_u.

D: displayed value in range of D_l and D_u.

Gain: G= $(D_u - D_1) / (M_u - M_1)$

Offset: $O = D_1 - (G \times M_1)$

Displayed value: $D = (G \times M) + O$

After calculating gain and offset, the user must change the values through the GUI or use the CMT (change the settings in the analog tab located in parameter panel).

⚠ CAUTION!

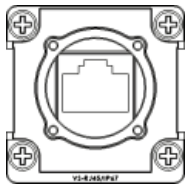
Voltages > 10Vdc or reversed polarity may lead to damage of the sensor input circuits

IMPORTANT!

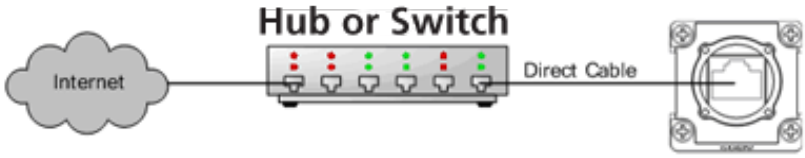
➡ System will show unexpected values if gain and offset are not properly set. Ensure that calculations are exact.

Ethernet

Target port figure



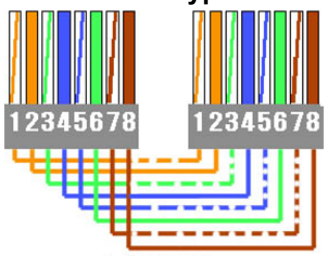
Connect the wires



Connector Type

RJ45

Cable Type



Direct (1:1)

NOTE: If using a direct cable connection to a computer, please use a crossover cable.

9. COMMISSIONING

⚠ DANGER!

Electric shock is possible from improper startup of the Inverter.

Death may result from burns and electric shock.

- All procedures described in this section may only be conducted by qualified personnel.

  If problems occur when performing the work described here, contact the technical support dept. at KACO new energy Inc. +1 (415) 931-2046.

Visual Inspection

Inspect all large power cables and bus connections throughout the inverter to verify that they are tight.

Verify that all PV wires are connected with the proper polarity and tightened to the proper torque specification.

Check the AC connections for proper phase rotation and that they are tightened to the proper torque specification.

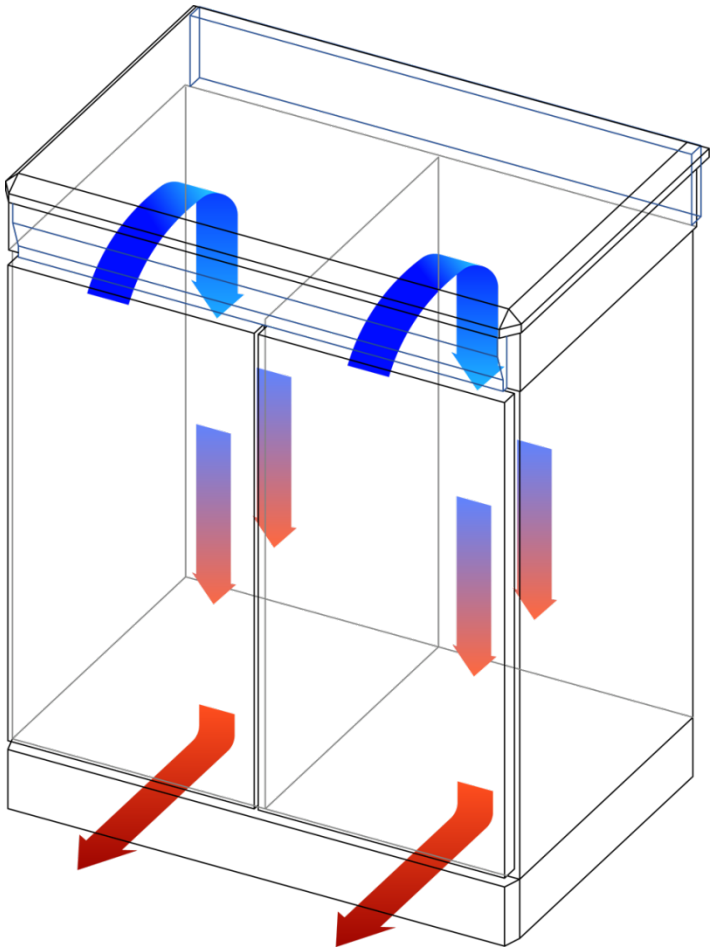
Verify that the AC and DC ground wires are connected correctly and tightened to the proper torque specification.

Inspect the interior of the Inverter to insure that it is clear of tools, foreign objects, water, debris or documents.

How to check the Ventilation

The Inverter is cooled by top quality variable speed fans.

In the Inverter, air flow is from the top front and expelled at the bottom in the front and back.



1. Check the ventilation air flow by placing a sheet of paper near the vents to ensure air is flowing.

2. If the Inverter does not suck air in or does not blow it out, contact the technical support dept. at KACO new energy Inc. +1 (415) 931-2046.

10. OPENING THE INVERTER

⚠ DANGER!

Electric shock is possible from improper startup of the Inverter.

Death may result from burns and electric shock.

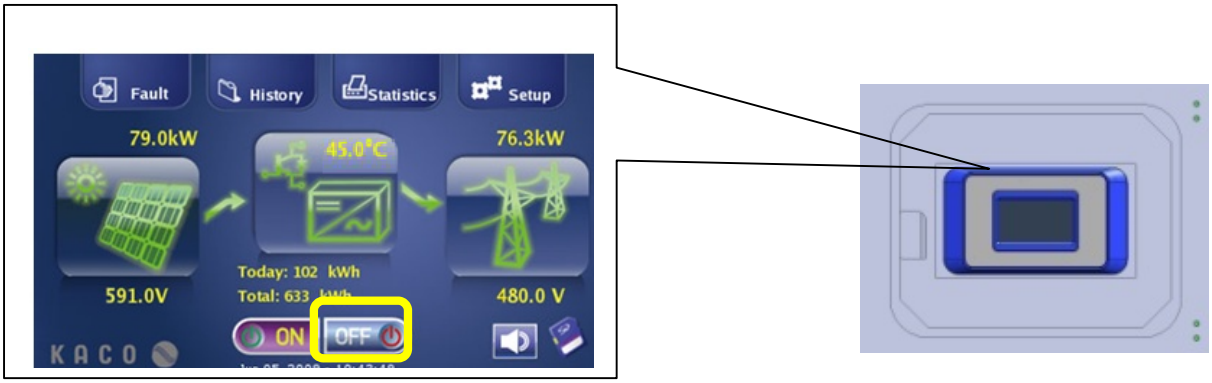
- All procedures described in this section may only be conducted by qualified personnel.

  If problems occur when performing the work described here, contact the technical support dept. at KACO new energy Inc. +1 (415) 931-2046.

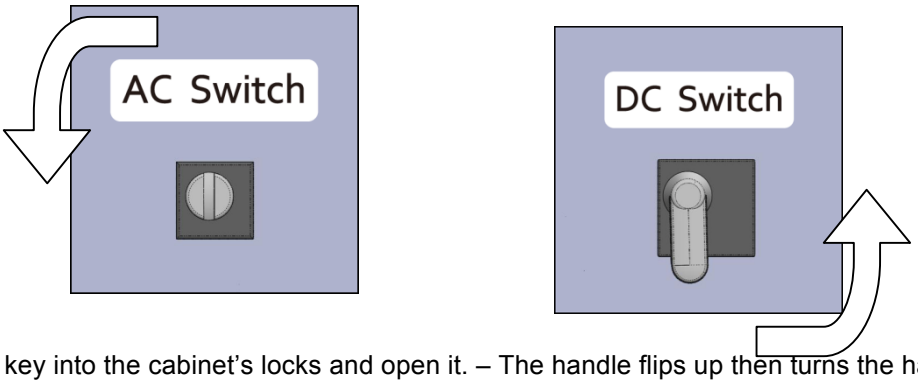
Opening the Inverter cabinet

1. Insert the key into the GUI lock and open the GUI cover.

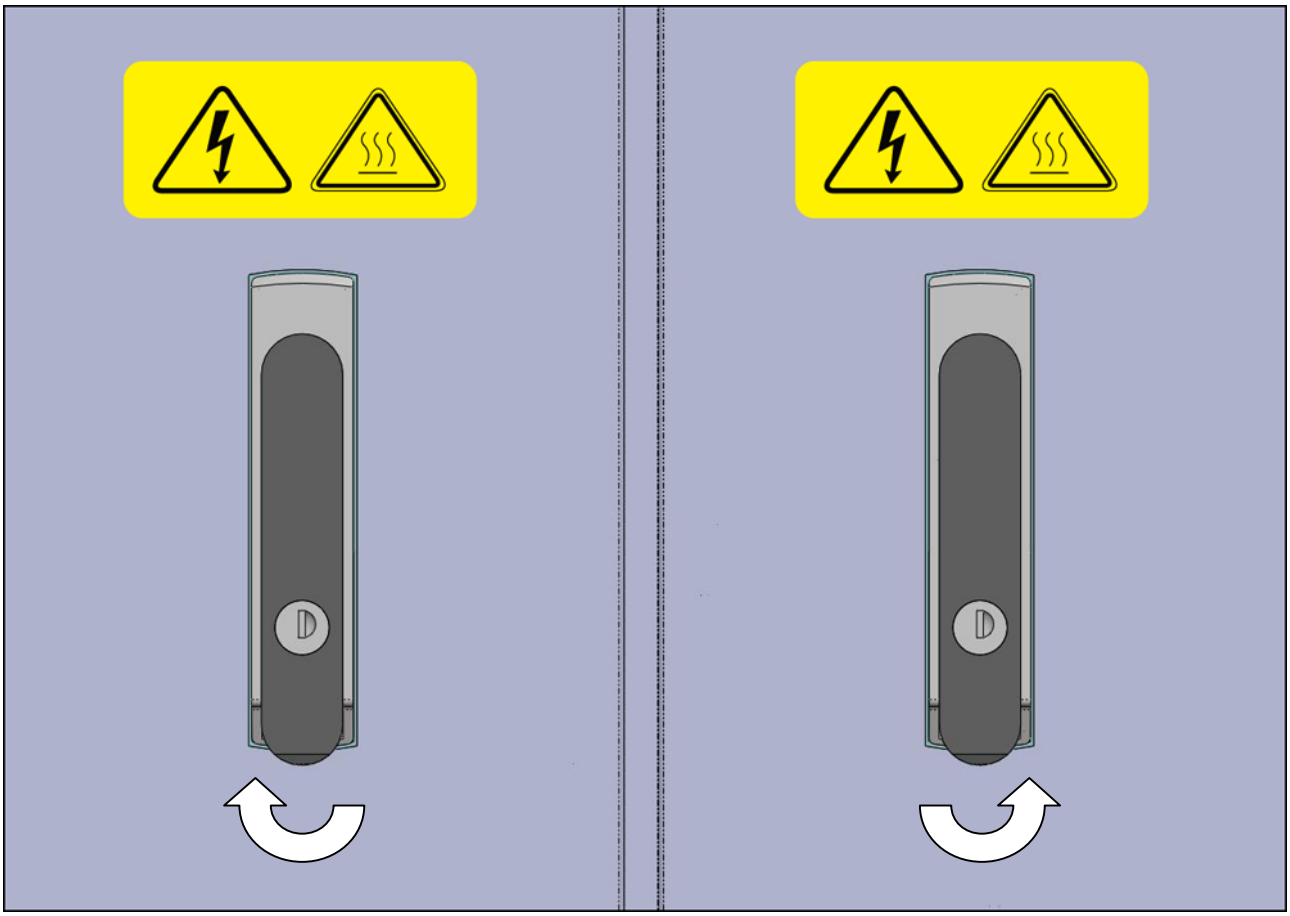
2. Press the ‘OFF’ button on screen for the Inverter to turn off and wait 1 minute.



3. Turn off the DC and AC switches.

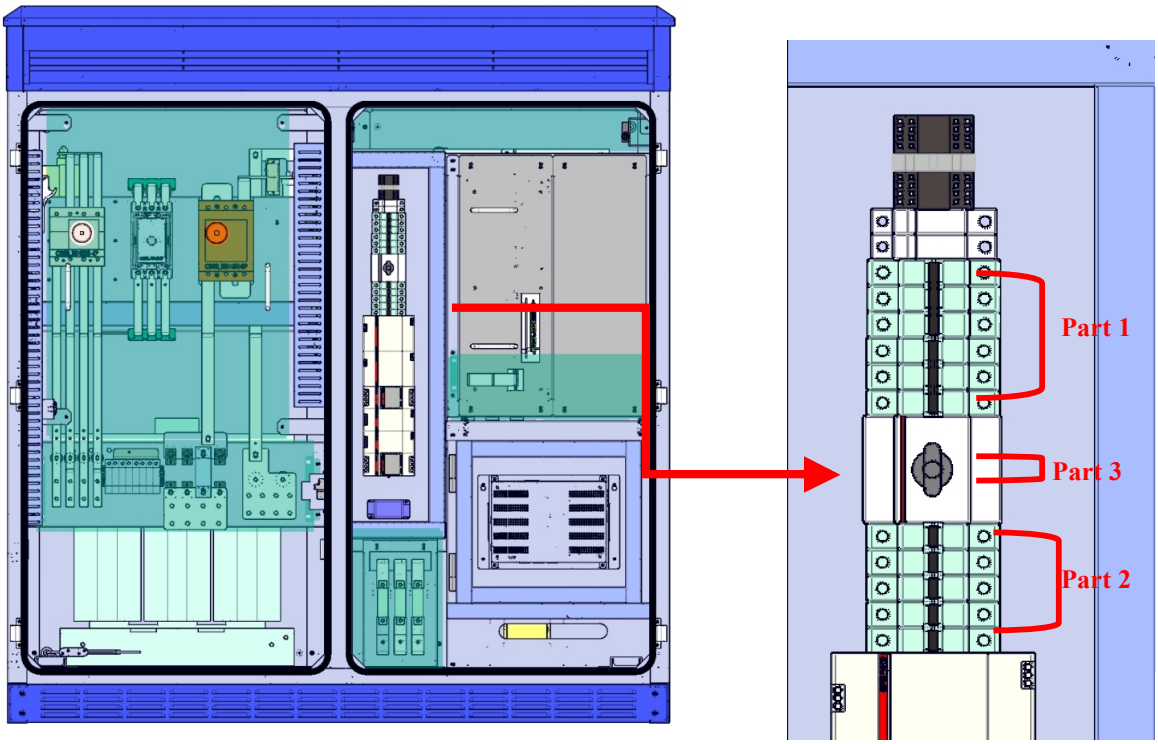


4. Put the key into the cabinet's locks and open it. – The handle flips up then turns the handle.



11. OPERATING

Startup Instructions



Inside of the Inverter

After installation and electrical connection, the Inverter will be ready for operation.

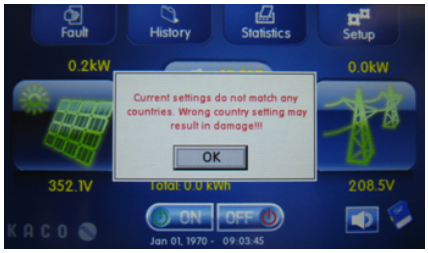
Follow these instructions.

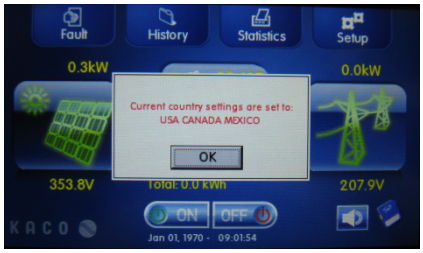
- Check that the switches in the part1 are turned on. If not, turn on the switches.
- Check that the switches in the part2 are turned on. If not, turn on the switches.
- Turn on the switch in the part3.
- Close the cabinet doors.
- Turn on the AC and DC, and disconnect switches on the left cabinet door.

⚠ DANGER!

High voltage may be present inside inverter. When turning off or on the switches, be careful not to touch conductors.

Switch on the grid voltage via the external breaker or switch. Switch on the solar generator via the DC disconnecting switch or DC plug-type connectors.





Once the inverter is connected, the GUI turns on. After about two minutes, the GUI will ask if you would like to

change the country settings. Select "NO". Note: If the GUI gives the warning "Current settings don't match and countries. Wrong country setting may result in damage!!", this is a bug , select 'Ok' and disregard. If the dialog "Current country settings are set to USA CANADA MEXICO" displays, select "OK" and disregard.

See GUI screen.

Touch the “ON” button on GUI screen.

If no fault is present the inverter will begin operation.

The inverter will start operating and GUI icons will be green.

GUI during proper operation

IMPORTANT!

The inverter can't be started when a fault is present. Use the 'fault reset' procedure and retry the start operation. Refer to the 'Fault & Warning' section for a description of the 'fault reset' procedure.
If the GUI gives a Code F16 or 'Inv. Phase Order' failure message, the phase rotation is reversed. Shut down the system, power off all AC and DC voltage to the inverter, and reverse the phase A and B connections on the AC field wiring terminals.

⚠ CAUTION!

If the fault isn`t resolved after 'fault reset' procedure is complete, contact the KACO technical dept. at +1 (415) 931-2046

Operating State

The Inverter has eight operating states. The explanations about each state are below.

Disconnected (default): Before operation has commenced the inverter is in the disconnected state. In this state, the inverter is totally isolated from the PV array and the utility grid.

Connecting to the PV array: When the inverter is in the "Disconnect" state, the 'Inverter On' button on the GUI is selected and the PV voltage is kept above 200V for 5 seconds, the system turns on the PV Array side contactor (PV_MC). In this state, if the PV voltage falls below 100V, the inverter returns to the Disconnect state.

Connecting to Grid: When the inverter is in the "Connecting to PV Array" state and the PV voltage is kept above the value of "MPPT V Start" parameter during the time set by "MPPT T start" parameter, the contactor on the grid side is turned on. The inverter keeps this state for 8 seconds.

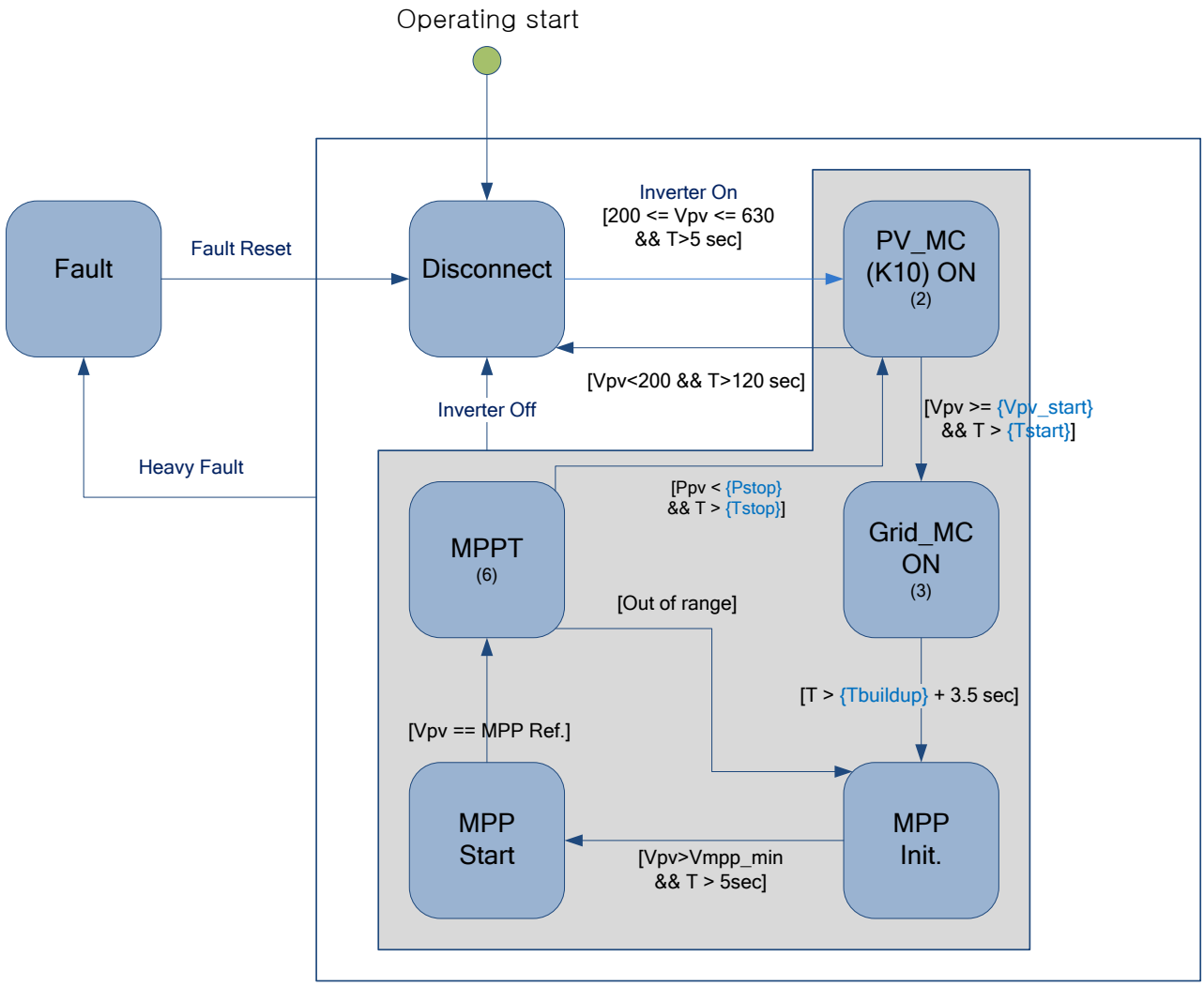
Initializing MPP: The inverter calculates the MPPT start voltage which is product of measurement of PV voltage and the parameter "MPP Factor". After 5 seconds, the inverter system enters into the "MPP start" state.

MPP start: In this state, the inverter controls the PV voltage. Reference of the PV voltage ("V_{dc} reference" parameter) the inverter changes from "open circuit" voltage to the value of the "MPPT V start" parameter.

MPPT: If the PV voltage approximates the MPP start voltage (value of “MPPT V Start” parameter), the MPPT will start. The inverter follows the MPP target value automatically, which is varied by irradiance values. If the MPP target value is out of the allowable MPPT range ([MPP start voltage – MPP Range lower] ~ [MPP start voltage + MPP range upper]), the system will return to the “Initializing MPP” state and will recalculate the MPPT start voltage.

System stop: When the “OFF” button in the GUI is selected, the PV Array side contactor and the Grid side contactor are turned off and the system stops. If the output power of inverter is kept below value of “MPPT P stop” parameter during time of “MPPT T stop” parameter, connection to the grid is terminated. In addition, If PV voltage is below 100V, the inverter stops.

Fault: If a fault occurs during operation, the system stops. The system resets the fault and tries to remove the fault. In the case that system removes a fault successfully, system restarts all by itself. The system allows three auto fault resets within 30 minutes. After three attempts, the system will log an error and the system will not try to restart.



12. PARAMETERS

DATE-TIME PARAMETERS

Parameters	Units	Ranges	Descriptions	Default
Year	N/A	2000~3000	Current year.	-
Month	N/A	1~12	Current month.	-
Date	N/A	1~31	Current day.	-
Time	N/A	0~23	Current hour	
Minute	N/A	0~59	Current minute.	
Second	N/A	0~59	Current second.	

DIGITAL INTERFACE PARAMETERS

Parameters	Units	Ranges	Descriptions	Default
DI1 Select	N/A	0~20	Selection for digital input1	0
DO1 Select	N/A	0~20	Selection for digital output1	0
DO2 Select	N/A	0~20	Selection for digital output2	0
Power Meter	kWh	0~99999999		0
RS485 Protocol	N/A	0~999	0 : ACI protocol 1 : Protocol for the prolog 2 : Protocol for the PVI-go	0

RS485 ID	N/A	0~999	ID for communication with RS485	0
CAN ID	N/A	0~999	ID for communication with CAN	0

ANALOG INTERFACE PARAMETERS

Parameters	Units	Ranges	Descriptions	Default
AI1 Offset	N/A	-300~300	Value of offset for analog input1	0
AI1 Gain	N/A	-300~300	Value of gain for analog input1	120
AI2 Offset	N/A	-300~300	Value of offset for analog input2	20
AI2 Gain	N/A	-300~300	Value of gain for analog input2	10.87
AI3 Offset	N/A	-300~300	Value of offset for analog input3	50
AI3 Gain	N/A	-300~300	Value of gain for analog input3	10

NETWORK PARAMETERS

Parameters	Units	Ranges	Descriptions	Default
Config	N/A	0,1	0:DHCP 1:Static	1
IP	N/A		IP address in the form of “xxx.xxx.xxx.xxx”	1
Netmask	N/A		Netmask used for the Network. Its form is “xxx.xxx.xxx.xxx”	0
Gateway	N/A		Address for the router in the form of “xxx.xxx.xxx.xxx”	1

RECORDING PARAMETERS

Parameters	Units	Ranges	Descriptions	Default
Recording Interval	min	10~60	A period for recording parameters	10
Grid Power	N/A	On(1), Off(0)	If off the Grid power isn't recorded	On(1)
PV Power	N/A	On(1), Off(0)	If off the PV Power isn't recorded	On(1)
PV Voltage	N/A	On(1), Off(0)	If off the PV Voltage isn't recorded	On(1)
PV Current	N/A	On(1), Off(0)	If off the PV current isn't recorded	On(1)
PV Temp.	N/A	On(1), Off(0)	If off the PV Temperature isn't recorded	On(1)
Irradiation	N/A	On(1), Off(0)	If off the Irradiation isn't recorded	On(1)
Delete All Statistics	N/A	N/A	Delete all statistics data.	N/A

13. FAULTS & WARNINGS

When a problem occurs in the system, the Inverter will beep and inform the user on the GUI. The Inverter displays two basic error messages. The first, the fault, is a serious problem that causes the inverter to stop running. The second, a warning, is a minor problem that does not cease the system operation. The GUI will indicate faults in red and warnings in yellow. The user can find a description of the different fault and warnings in the following tables.

WARNING AND FAULT TABLES

Warning

Message	Code	Description
SP1(PV SP) Failure	W01	Failure of the PV side surge protector(SP1)
Reserved	W02	Reserved
PV Fuse Failure	W03	PV side Fuse failure(option)
Ground Fault Warning	W04	The insulation resistance of the PV falls short of the limit set in the ground fault monitoring for Alert1(option)
Reserved	W05~W19	Reserved
PEBB Over Temp. Warning	W20	The temperature of the PEBB(Power Electronics Building Block) heatsink exceeds 75℃(167℉)
PEBB Fan Failure	W21	Failure of a PEBB(Power Electronics Building Block) fan
Reserved	W22~W29	Reserved
SP2(Grid SP) Failure	W30	Failure of the grid side surge protector(SP2)
Reserved	W31~W39	Reserved
Test Mode	W40	The system is working in test mode

Reserved	W41~W49	Reserved
Cabinet Over Temp. Warning	W50	The temperature of the cabinet exceeds the operational parameter [Cabinet Temperature Maximum]
Cabinet Under Temp. Warning	W51	The temperature of the cabinet falls below the operational parameter [Cabinet Temperature Minimum]
Reserved	W52~W53	Reserved
Control SMPS Failure	W54	Failure of the control SMPS (Switching Mode Power Supply)
Reserved	W55	Reserved
Fan SMPS Failure	W56	Failure of the fan SMPS (Switching Mode Power Supply)
Reserved	W57	Reserved
Cabinet Fan Failure	W58	Failure of a cabinet fan

Fault

Message	Code	Description
PV Over Voltage	F01	PV voltage exceeds the parameter [DC over voltage Level]
PV Over Current	F02	PV current exceeds the parameter [DC over current Level]
PV Under Voltage	F03	Voltage of the DC input is below the minimum running voltage
K10 (PV Contactor) Failure	F04	PV side contactor (K10) failure
PV Polarity Failure	F05	Polarity (+, -) of PV side is reversed
Ground Fault	F06	PV side ground fault
S10(PV Switch) Trip	F07	S10 (PV Disconnect Switch) tripped during operation
Reserved	F08~F09	Reserved

Inv. Over Voltage	F10	Over voltage on the inverter side
Inv. Under Voltage	F11	Under voltage on the inverter side
Inv. Over Frequency	F12	Over frequency on the inverter side
Inv. Under Frequency	F13	Under frequency on the inverter side
Inv. Over Current	F14	Over current on the inverter side
MC21(Inv. MC) Failure	F15	Inverter side contactor (MC21) failure
Inv. Phase Order	F16	Phase order failure on the inverter side, wrong phase rotation
Inductor or TR Over Temp.	F18	Inductor or Transformer temperature is above 150 C
Reserved	F19	Reserved
PEBB 1 IGBT Fault	F20	PEBB 1 IGBT failure
PEBB 2 IGBT Fault	F21	PEBB 2 IGBT failure
PEBB 3 IGBT Fault	F22	PEBB 3 IGBT failure
Reserved	F23	Reserved
PEBB Over Temp. Analog	F24	The temperature of the heat-sink exceeds 90℃ (194 F).
PEBB Over Temp. Digital	F25	The heat-sink temperature generated by the thermal trip device has exceeded operational parameters (Thermal Switch)
Reserved	F26~F29	Reserved
Grid Over Voltage	F30	Over voltage on the grid side
Grid Under Voltage	F31	Under voltage on the grid side
Grid Over Frequency	F32	Over frequency on the grid side

Grid Under Frequency	F33	Under frequency on the grid side
CB20(Grid SW) Trip	F34	CB20 (AC Disconnect/Grid circuit breaker) was tripped during operation
Reserved	F35~F39	Reserved
Parameters Version Error	F40	Different version between the NVSRAM parameter table and the program parameter table
Flash Memory Failure	F41	C6000 DSP program flash memory failure in XCU (main control) board
FPGA Failure	F42	FPGA failure in XCU (main control) board
DSP28x Failure	F43	F2000 DSP failure in XCU (main control) board
ADC Failure	F44	ADC block failure in XCU (main control) board
Reserved	F45~F49	Reserved
Emergency Stop	F50	A door is open
Cabinet Over Temp.	F51	Temperature of cabinet is too high. Inverter has stopped operation

14. MAINTENANCE

Insulating gloves must be used during maintenance.

The Inverter needs to be periodically maintained.

IMPORTANT!

All service MUST be done by authorized personnel only.

DANGER!

DC terminals may be energized. Allow ten minutes for all capacitors within the main Enclosure to discharge after disconnecting the Inverter from AC and DC sources. Before touching any electrical connections make certain that no hazardous live voltage is present.

De-Energize/Isolation Procedure

The following procedure should be followed to de-energize the Inverter for maintenance.

To isolate the Inverter:

1. Turn the main ON/OFF switch in the GUI to the OFF position.

2. Open the utility connection circuit breaker.

3. Open the AC Disconnect.

4. Open the DC Disconnect Switch.

5. Install lockout devices on the utility connection circuit breaker, AC and DC disconnect switches.

6. Before touching any electrical connections make certain that no hazardous live voltage is present.

Maintenance includes:

A. Inspection of parts which may become worn and repairing or exchanging them

B. Functional testing of components

C. Inspection of connections

D. If needed - cleaning of the cabinet exterior / interior

NOTE: Maintenance frequency is dependent on the location and environmental conditions.

The Inverter can function in dusty environments but must be maintained more frequently than is recommended in the following table.

Time intervals for maintenance work

Maintenance work	maintenance interval (recommended)
Cleaning or replacing of the filter mats in the air intake	6 months *
Clean the heat sink-power section	12 months *
Inspection of a cabinet for strong dust sedimentation, pollution, moisture and water penetration from the outside.	12 months
Inspection of all warning labels, replace if necessary.	12 month
Function test of the fans	12 month
Visual inspection of fuses, breakers and surge protection	12 month
Visual inspection of redundant auxiliary power supplies	12 month
Function test of the door contacts	12 month
Inspection of the run and fault indicators	12 month

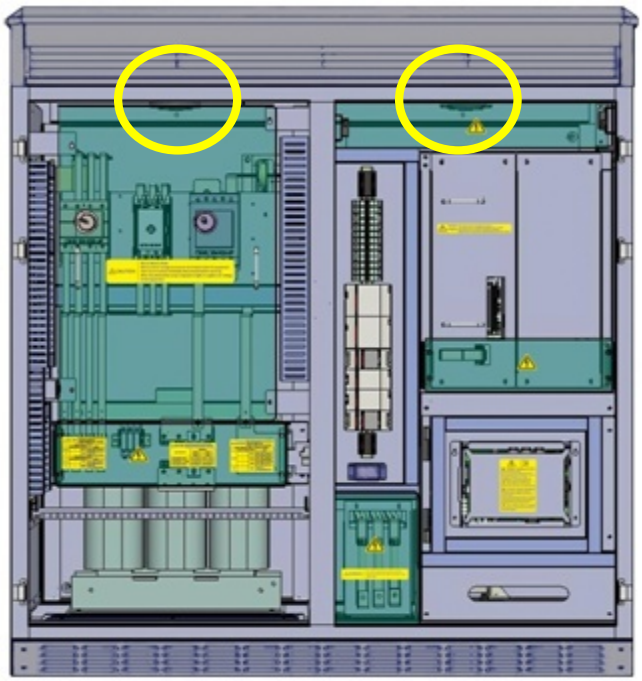
* If the installation site is especially dirty, maintenance intervals will be reduced.

Cleaning and replacing fans

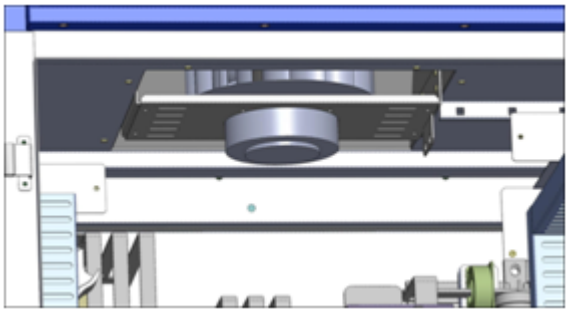
The fans should be cleaned periodically to ensure optimum performance. They should be replaced and/or serviced if an air flow issues arises. The Inverter includes two cabinet fans and one PEBB fan assembly.

Cabinet fan

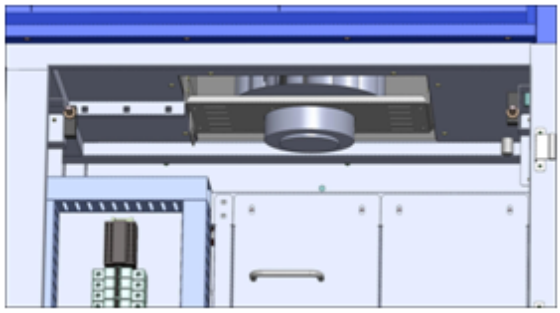
1. Switch off the inverter according to the inverter shutdown directions in the safety instruction section.
2. Open the front doors. You can find the fans on the top of the cabinet as below pictures.



3. Clean or replace fans.



Left cabinet fan

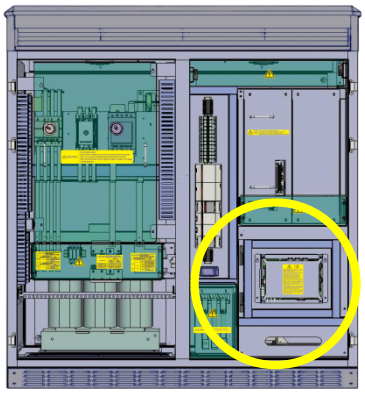


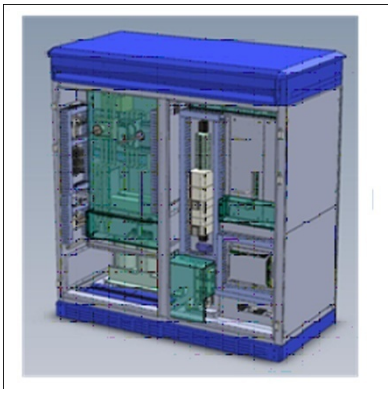
Right cabinet fan

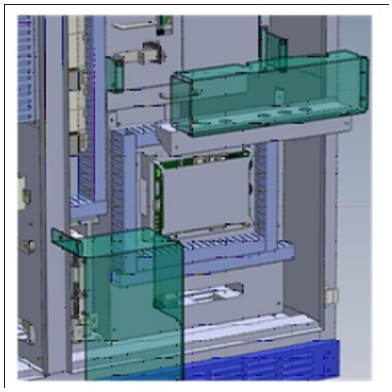
Caution! **When assembling a new fan ensure that the air flow direction is correct!**

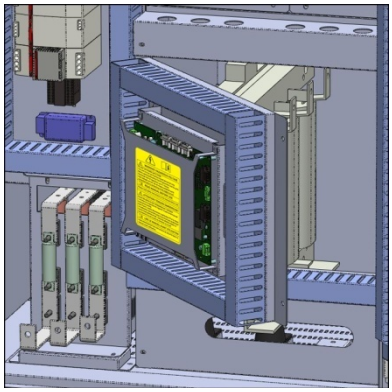
PEBB fan assembly

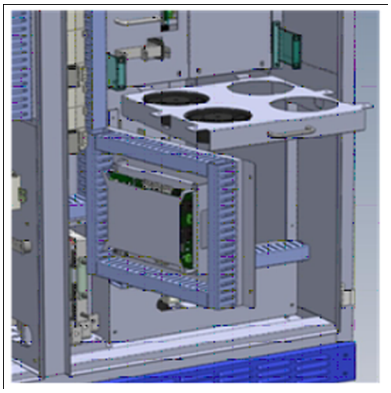
1. Switch off the inverter according to inverter shutdown direction in safety instruction section.
2. Open the PCB module doors. Find the PEBB fans under the IGBT stack as shown in the pictures below.
3. Clean or replace fans.

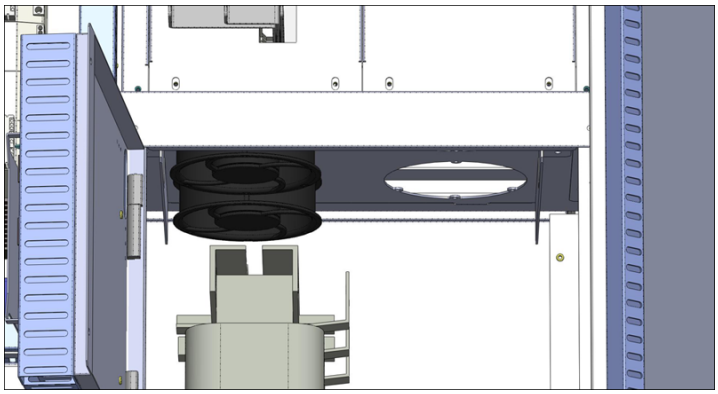












Caution! **When assembling a new fan ensure that the air flow direction is correct!**

15. ERROR CODES

The Inverter can detect faults during operation. The inverter will display the fault in the GUI. Faults are indicated in the GUI with an error code, and a plain text message with the error code and system plant name in the text line will be sent to the system operator (only available if purchased and configured during setup). This section describes how to recognize the types of faults and how to correct these faults.

Warnings

Code	Message	Warning description	Possible causes/Diagnosis
W01	SP1(PV SP) Failure	Failure of the PV side surge protector (SP1)	**Problem** • Lightning strike on or near the PV system wiring **Solution(s)** • Visual inspection • Change the SPD
W03	PV Fuse Failure	PV side Fuse failure(option)	**Problem** • PV system wiring short • Short circuit in the IGBT **Solution(s)** • Check the input current • Check module wiring • Change the FUSE
W20	PEBB Over Temp. Warning	The temperature of the heat-sink of the PEBB exceeds 75°C (167°F)	**Problem** • PEBB Fan Failure **Solution(s)** • Clean the filters or PEBB heat-sink fins • Change the PEBB Fan
W21	PEBB Fan Failure	PEBB heat-sink fan failure	**Problem** • PEBB Fan Failure **Solution(s)** • Change the PEBB Fan
W30	SP2(Grid SP) Failure	Failure of the grid side surge protector (SP2)	**Problem** • Lightning strike on or near the grid system wiring **Solution(s)** • Visual inspection • Change the SPD
W40	Test Mode	The system is working in test mode	**Problem** • The system is working in test mode **Solution(s)** • Change the parameters in the GUI
W50	Cabinet Over Temp. Warning	The temperature of the cabinet exceeds operational parameters	**Problem** • Cabinet Fan Failure **Solution(s)** • Clean the air filters • Change the cabinet fan
W51	Cabinet Under Temp. Warning	The temperature of the cabinet falls below operational parameters	**Problem** • Ambient temperature is too low for operation
W52	Control SMPS Failure	Failure of the control SMPS	**Possible causes** • Failure of the control SMPS **Solution(s)** • Change the control SMPS

Fault

Code	Message	Warning Description	Possible problem and solution(s)
F01	PV Over Voltage	PV voltage exceeds the parameter	**Problem** • The voltage of the solar generator is too high **Solution(s)** • Check the input voltage • Check module wiring and system
F02	PV Over Current	PV current exceeds the parameter	**Problem** • The current of the solar generator is too high • PV system wiring short **Solution(s)** • Check the input current • Check module wiring and system
F04	CB10 (PV CB) Trip	PV side circuit breaker(CB10) tripped	**Problem** • CB10 disconnect switch is open • Auxiliary switch is inoperable, K10 contactor failed closed **Solution(s)** • Check the wiring connection • Change the CB10, replace K10 contactor
F05	PV Polarity Failure	Polarity (+, -) of PV side is reversed	**Problem** • Polarity of PV side is reversed **Solution(s)** • Check the wiring connection and change if necessary
F06	Ground Fault	PV side ground fault	**Problem** • DC & ground are shorted causing the GFDI fuse to open **Solution(s)** • Check the solar generator for a ground fault and Replace the GFDI Fuse
F10	Inv. Over Voltage	Over voltage on the inverter side	**Problem** • The inverter voltage is too high **Solution(s)** • Check the inverter voltage • Check the inverter parameter
F11	Inv. Under Voltage	Under voltage on the inverter side	**Problem** • The inverter voltage is too low **Solution(s)** • Check the inverter voltage • Check the inverter parameter • Check the MC21
F12	Inv. Over Frequency	Over frequency on the inverter side	**Problem** • The grid frequency is outside the permitted range **Solution(s)** • Check the grid frequency
F13	Inv. Under Frequency	Under frequency on the inverter side	**Problem** • The grid frequency is outside the permitted range **Solution(s)** • Check the grid frequency
F14	Inv. Over Current	Over current on the inverter side	**Problem** • Short circuit in the IGBT • Short circuit in the Grid **Solution(s)** • Check the grid connection • Check the inverter connection

F15	MC21 Failure	Inverter AC side contactor failure	**Problem** • MC21 contactor is open • Auxiliary switch is inoperable **Solution(s)** • Check the wiring connection • Change the MC21
F16	Inv. Phase Order	Phase order failure on the inverter side	**Problem** • Phase order failure on the inverter • Wrong phase rotation **Solution(s)** • Check the wiring connection • Reverse two phases
F18	Inductor or TR Over Temp	Inductor or transformer temperature is above 150°C.	**Problem** • Cabinet fan failure **Solution(s)** • Cleaning the filters • Change the cabinet Fan
F20	PEBB 1 IGBT Fault	PEBB IGBT U failure	**Problem** • Short circuit in the IGBT **Solution(s)** • Visual inspection • Change the PEBB
F21	PEBB 2 IGBT Fault	PEBB IGBT V failure	
F22	PEBB 3 IGBT Fault	PEBB IGBT W failure	
F24	PEBB Over Temp. Analog	The temperature of the heat-sink exceeds operational parameters	**Problem** • PEBB fan failure **Solution(s)** • Clean the filters • Inspect and if necessary clean the heat-sink fins • Change the PEBB Fan
F25	PEBB Over Temp. Digital	The heat-sink over temperature generated by the thermal trip device	**Problem** • PEBB Fan Failure **Solution(s)** • Inspect and if necessary clean the heat-sink fins Change the PEBB Fan
F30	Grid Over Voltage	Over voltage on the grid side	**Problem** • The grid voltage is too high **Solution(s)** • Check the grid voltage • Check the grid parameter
F31	Grid Under Voltage	Under voltage on the grid side	**Problem** • The grid voltage is too low **Solution(s)** • Check the grid voltage • Check the grid parameter • Check the MCB24
F30	Grid Over Voltage	Over voltage on the grid side	**Problem** • The grid voltage is too high **Solution(s)** • Check the grid voltage • Check the grid parameter
F31	Grid Under Voltage	Under voltage on the grid side	**Problem** • The grid voltage is too low **Solution(s)** • Check the grid voltage • Check the grid parameter • Check the MCB24
F32	Grid Over Frequency	Over frequency on the grid side	**Problem** • The grid frequency is outside the permitted rang **Solution(s)** • Check the grid frequency

F33	Grid Under Frequency	Under frequency on the grid side	**Problem** • The grid frequency is outside the operation range **Solution(s)** • Check the grid frequency
F34	CB20(Grid SW) Trip	CB20(AC disconnect grid circuit breaker) was tripped during operation	**Problem** • Short circuit in the grid **Solution(s)** • Check the wiring connections
F40	Parameters Version Error	Different version between the NVSRAM parameter table and the program parameter table	**Problem** • Different version between the NVSRAM parameter table and the program parameter table **Solution(s)** • Initialize the parameter menu setting in the GUI and reset faulted parameter • Change the PCB module
F41	Flash Memory Failure	C6000 DSP program flash memory failure in XCU (main control) board	**Problem** • Internal C6000 error **Solution(s)** • Change the PCB module
F42	FPGA Failure	FPGA failure in XCU (main control) board	**Problem** • Internal FPGA error **Solution(s)** • Change the PCB module
F43	DSP28x Failure	F2000 DSP failure in XCU (main control) board	**Problem** • Internal F2000 error **Solution(s)** • Change the PCB module
F44	ADC Failure	ADC block failure in XCU (main control) board	**Problem** • Internal A to D converter error **Solution(s)** • Change the PCB module
F50	Emergency Stop	The door is open	**Problem** • Front door is open • Broken or out of alignment door switch **Solution(s)** • Close the door • Align or replace door switch

16. SPECIFICATIONS

The Inverter Specifications

1. DC

Specification	XP100U-H2 XP100U-H4	XP83U-H6	XP90U-H6	XP100U-H6
Maximum PV Power	105kW	87.5kW	95kW	105kW
Range of input operating voltage	300 ~ 600V			
Maximum input voltage	600V			
Maximum input current	350A	292A	317A	350A
Maximum input short circuit current	410A	380A	380A	476A
Maximum input source backfeed current	0A			

2. AC

Specification	XP100U-H2	XP100U-H4	XP83U-H6	XP90U-H6	XP100U-H6
Rated power	100kW		83kW	90kW	100kW
Output Power factor	≥ 0.99 at rated power				
Nominal output voltage **(+10% to -12% acceptable range)**	3-phase 208V (184 to 228V)	3-phase 480V (422 to 528V)	3-Phase 600V (528 to 660V) Canada certification Only		
Nominal output frequency **(acceptable range)**	60Hz (59.3 to 60.5Hz)				
Maximum continuous output current	277A	120A	80A	87A	96A

Maximum continuous output power	100kW		83kW	90kW	100kW
Maximum output fault current	277A	121A	80A	87A	96A
Maximum output over current protection	400A	150A	125A		
Synchronization in-rush current	20A				
AC current distortion	< 3% at rated power				
Trip limit and trip time accuracy	Voltage trip limit: 1% Voltage trip time: 1 % Frequency trip limit: 0.1 % Frequency trip time: 0.1%				

3. Efficiency

Specification	XP100U-H2/ XP100U-H4/XP83U-H6/ XP90U-H6/ XP100U-H6
CEC efficiency (H2 and H4 models only)	96%
Maximum efficiency	96.5%

4. Power Consumption

Specification	XP100U-H2/ XP100U-H4/ XP83U-H6/ XP90U-H6/ XP100U-H6
Stand-by and Night tare loss	< 65W

5. Environmental Parameters

Specification	XP100U-H4/ XP100U-H2 XP83U-H6/ XP90U-H6/ XP100U-H6
Storage temperature range	-5℉ (-20℃) ~ +158℉ (+70℃)
Normal Operating temperature range	-5℉ (-20℃) ~ +122℉ (+50℃)
Full power operating ambient	-5℉ (-20℃) ~ +122℉ (+50℃)
Relative humidity	0 - 95% (non-condensing-internal dehumidifier standard)
Elevation	6600ft (2000m)
Cooling	Fan forced, max 4460m^3/h
Audible noise	< 65dB

6. Standard

Specification	XP100U-H2/ XP100U-H4	XP83U-H6/ XP90U-H6/ XP100U-H6
General Standard	UL1741 Rev 2005, IEEE1547, IEEE1547.1 CAN/CSA C22.2 No. 107.1	IEEE1547, IEEE1547.1 CAN/CSA C22.2 No.107.1 (Canada certification Only)
Emitted Interference	FCC Class A	

7. Interface

Specification	XP100U-H2/ XP100U-H4 XP83U-H6/XP90U-H6/XP100U-H6
Display	TFT－LCD with Touch Screen
Digital/Analog I/O Ports	1 Digital input 1 Digital output 1 S0 input 1 S0 output 4 Analog inputs
Data communication	2 RS485/1 CAN/1 Ethernet
Memory	SD-Card up to 8GB

8. Enclosure

Specification	XP100U-H2	XP100U-H4	XP83U-H6/ XP90U-H6/ XP100U-H6
Height Width Depth(mm)	73 x 68 x 36in. (1840 x 1724 x 930mm: H, W, D)		
Weight(kg)	3086lbs (1400kg)	3086lbs (1400kg)	2425lbs (1100kg)
Protection Class	NEMA 3R		

9. Overvoltage, under voltage and Frequency ranges

Voltage Range (% of Nominal)	System Condition	XP100U-H2	XP100U-H4	XP83U-H6/ XP90U-H6/ XP100U-H6	Trip Time
Vac<50%	Grid Minimum Voltage	Vac<104	Vac<240	Vac<300	10 cycles
50%≤Vac<88%	Grid Under Voltage	104≤Vac<184	240≤Vac<423	300≤Vac<528	2 seconds
88%<Vac≤110%	Normal Operation	184<Vac≤228	422<Vac≤528	528<Vac≤660	-
110%<Vac≤120%	Grid Over Voltage	228<Vac≤249	528<Vac≤576	660<Vac≤720	1 second
120%≤Vac	Grid Maximum Voltage	249≤Vac	576≤Vac	720≤Vac	10 cycles

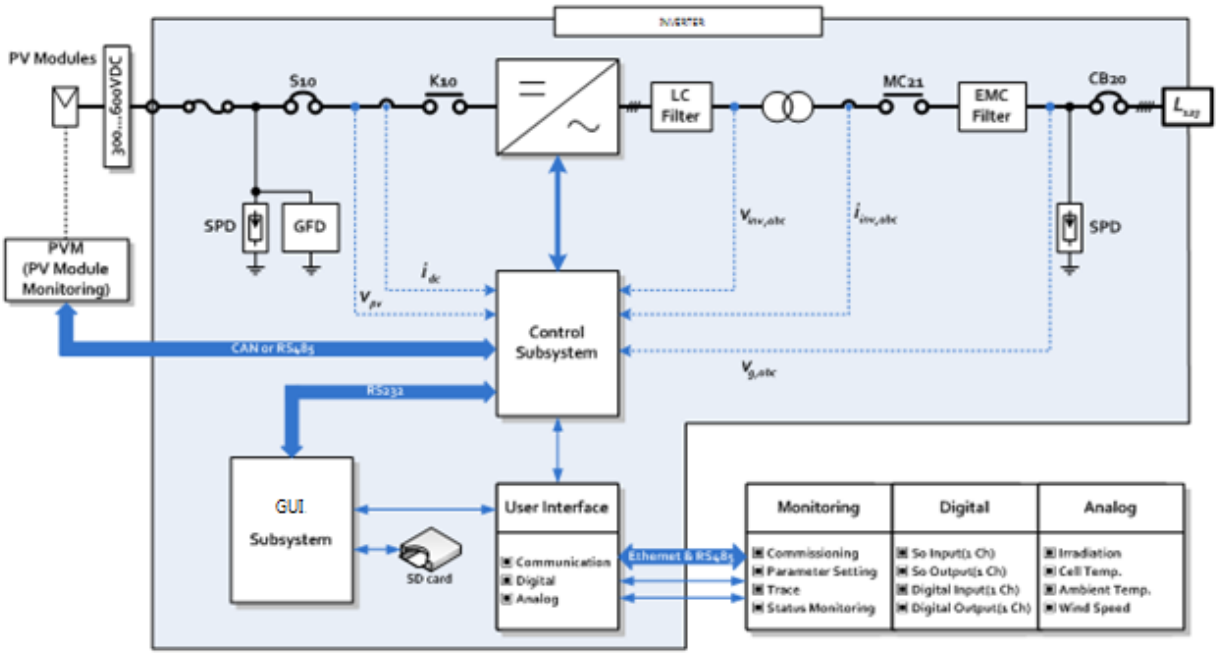
Grid Frequency Range

Every voltage and frequency range is adjustable and password protected.

Frequency Range	System Condition	XP100U-H2/ XP100U-H4 XP83U-H6/XP90U-H6/XP100U-H6	Trip Time
f<rated-3.0	Grid Minimum Frequency	f<57.0	10 cycles
f<rated-0.7	Grid Under Frequency	f<59.3	10 cycles
rated-0.7≤f≤rated+0.5	Normal Operation	59.3≤f≤60.5	-
f>rated+0.5	Grid Over Frequency	f>60.5	10 cycles

17. CONFIGURATION

The Inverter Block Diagram



Block Diagram of the Inverter

18. CERTIFICATIONS

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Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Taiwan

Control Number: *3189197* **Authorized by:** Jason Lau for

William T. Starr, Certification Manager

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Intertek Testing Services NA Inc.
165 Main Street, Cortland, NY 13045
Telephone 800-345-3851 or 607-753-6711 Fax 607-756-6699

Standard(s):	Standards for Inverters, Converters, Contollers and Interconnection System Equipment for Use With Distributed Energy Resources (UL 1741, 1st Ed. Dated May 7, 1999; Revision Dated November 7, 2005) and General Use Power Supplies (CAN/CSA C22.2 No.107.1-01, Dated September 2001, Reaffirmed 2006).
Product:	PV inverter
Brand Name:	KACO new energy
Models:	XP100U-H2

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Product:	PV inverter
Brand Name:	KACO new energy
Models:	XP100U-H4

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Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Taiwan

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Standard(s):	Standards for General Use Power Supplies (CAN/CSA C22.2 No.107.1-01, Dated September 2001, Reaffirmed 2006).
Product:	PV inverter
Brand Name:	KACO new energy
Models:	XP100U-H6, XP90U-H6 and XP83U-H6

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Report Issuing Office: Taiwan

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Standard(s):	Standards for General Use Power Supplies (CAN/CSA C22.2 No.107.1-01, Dated September 2001, Reaffirmed 2006).
Product:	PV inverter
Brand Name:	KACO new energy
Models:	XP100U-H6, XP90U-H6 and XP83U-H6